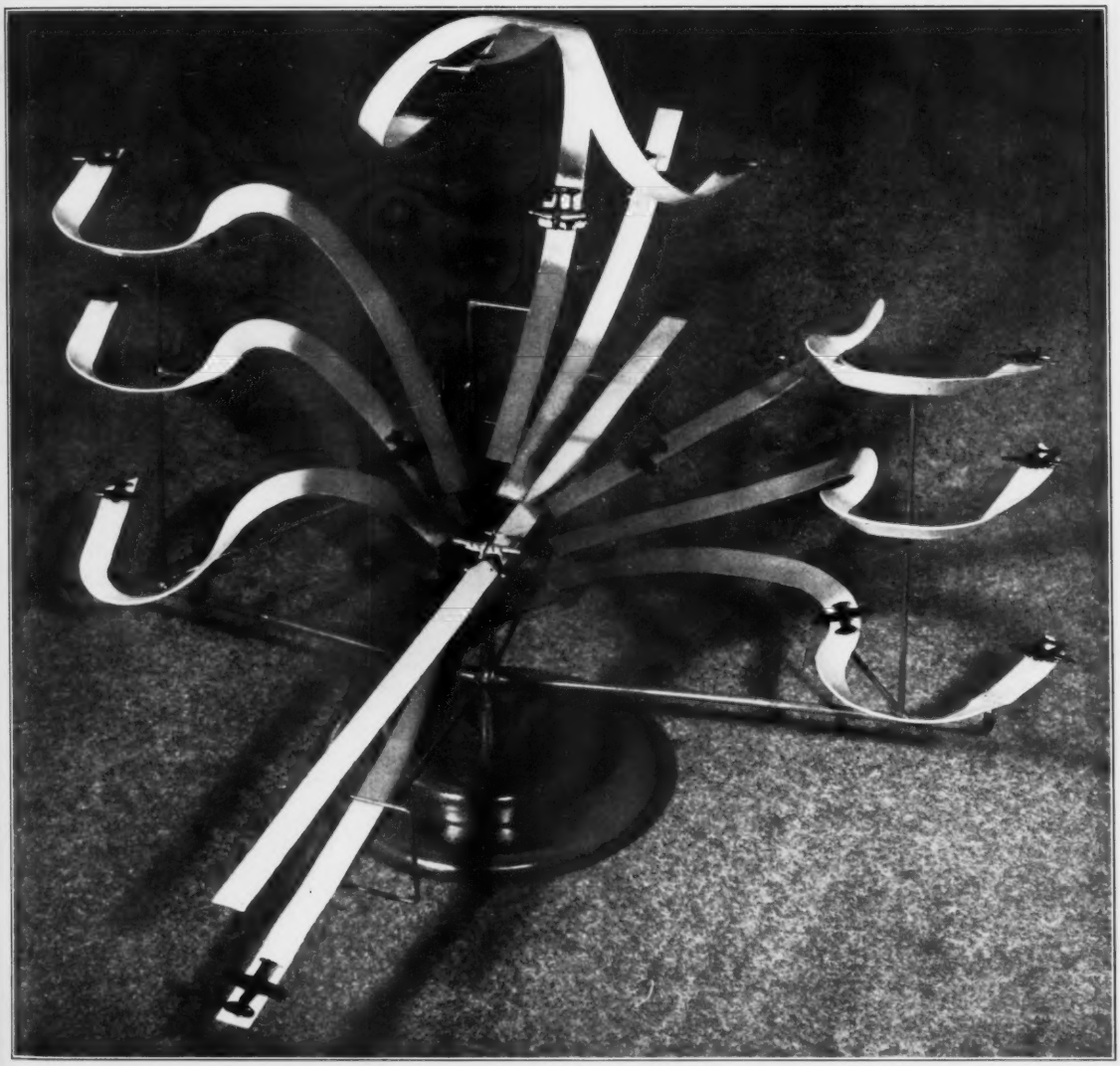
457

AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES
PRINCETON UNIVERSITY LIBRARY
RECEIVED JUN 25 1945

JUNE 1945



HEADQUARTERS FOR PRECISION ENGINEERED PUMPS

The success of your post-war commercial units will be vitally influenced by the quality of pumps you use as standard equipment.

For nearly two decades ROMEC has specialized in the development and manufacture of PRECISION-ENGINEERED PUMPS. We have passed through a long course in the school of experience—meeting and solving many problems of pressure, weight, space and corrosion.

If you contemplate the product improvement that goes with better pump performance, we invite you to stand by until we are "over the hump" on our present military and naval aircraft work. That may come sooner than we think. Then we can serve you as effectively as we are now serving the Armed Forces.

ROMEC PUMP COMPANY, 121 ABBE ROAD, ELYRIA, OHIO, U. S. A.

Romec

BUY MORE WAR BONDS

AERONAUTICAL ENGINEERING REVIEW

Published Monthly by the Institute of the Aeronautical Sciences, Inc., as a Part of the Services of the Aeronautical Archives

ABC

June, 1945

VOLUME 4 NUMBER 6

Copyright, 1945, by the Institute of the Aeronautical Sciences, Inc.

OFFICERS

President
Charles H. Colvin

Past-Presidents
J. C. Hunsaker
Charles L. Lawrance
D. W. Douglas
Glenn L. Martin
Clark B. Millikan
T. P. Wright
George W. Lewis
James H. Doolittle
Frank W. Caldwell
Hall L. Hibbard
Hugh L. Dryden
R. H. Fleet

Vice-Presidents
W. A. M. Burden
Leroy R. Grumman
I. M. Laddon
Arthur E. Raymond

Executive Vice-President
Bennett H. Horchler

Treasurer
Earl D. Osborn

Assistant to the President
George R. Forman

Secretary
Robert R. Dexter

Controller
Joseph J. Maitan

Council
Lester D. Gardner, *Chairman*
P. R. Bassett
Rex B. Beisel
George W. Brady
William K. Ebel
Sherman M. Fairchild
Charles Froesch
R. Paul Harrington
C. S. Jones
Otto E. Kirchner
John C. Leslie
Alfred Marchev
Elmer A. Sperry, Jr.

SUBSCRIPTION RATES

Aeronautical Engineering Review: United States and possessions, 1 year, $3.00; single copies, $0.30. Foreign countries including Canada (American Currency Rates), 1 year, $3.50; single copies, $0.35.

Journal of the Aeronautical Sciences: Published Quarterly in January, April, July, and October. United States and possessions, 1 year, $7.00; single copies, $2.00. Foreign countries including Canada (American Currency Rates), 1 year, $9.00; single copies, $2.50.

Entered as second-class matter at the Post Office, Easton, Pa., April 29, 1942. Acceptance for mailing at a Special Rate of Postage as provided for in the Act of August 24, 1912.

Publication Office: 20th & Northampton Streets, Easton, Pa.

Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Notices of change of address should be sent to the Institute at least 30 days prior to actual change of address.

Statements and opinions expressed in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.

CONTENTS

Cover Illustration

The type Q-10 pursuit curve demonstrator, developed by the Training Aids Division of the Office of the Assistant Chief of Air Staff, Training, and the Air Technical Service Command, to train fighter pilots and bomber gunners. Photograph Courtesy *Air Force Magazine*.

Articles

Design Principles for Electrical Landing-Gear Control Systems . . . . . Harvey J. Finison 5

Some Design Considerations of Electrohydraulic Power Supply Systems . . . . . Walter C. Trautman 21

Aircraft Electrical Equipment . . . . . T. B. Holliday 29

Reviews

Periodicals 55

Government Publications 93

Books 115

House Organs and Catalogues 131

From the Industry 145

General

Institute News 43

Source Material 107

Appreciation to Corporate Members 164

Index to Advertisers 167

George R. Forman, *Editor* Russell F. Rogers, *Manager*

Harris F. Reeve, *Managing Editor*

Associate Editors: Gail Wadro, Berneice H. Jarck, Edward G. Ingram

Always Nearer to Nippon

FLOAT Planes, Kingfisher OS2Us, act as the "eyes" of our fleets, scouting the waters ahead as we close in on the Japs.

They seek out targets beyond the horizon . . . and spot for the battleships' big rifles.

They search the seas for our overdue planes and crews and have run up a record for rescues that has earned them imperishable fame as "the mercy ships of the air".

It is the ability of the OS2U to take it—in punishing choppy-water landings, in rough weather action under service conditions, that has made this rugged little ship so indispensable for so long.

Edo Floats are standard equipment on Navy seaplanes.

OS2Us are shot from the decks of our cruisers by an explosive charge that accelerates them to "flying-speed" in the length of the catapult track. On return they land in the water to be picked up alongside by a hoist and lifted back onto the catapult carriage ready for the next mission.

ARMY E NAVY

EDO FLOAT GEAR

SERVES THE UNITED NATIONS

EDO AIRCRAFT CORPORATION, 413 SECOND STREET, COLLEGE POINT, L. I., N. Y.

Design Principles for Electrical Landing-Gear Control Systems

HARVEY J. FINISON*
Wright Field

Introduction

Complete reliability of operation is the prime objective in the design of a landing-gear system.

Reliable electrical landing-gear systems can readily be achieved if certain basic philosophies are followed in designing the control system. Investigation of a number of aircraft accidents resulting from landing-gear failures has revealed that on present aircraft the control-circuit practices being followed frequently invite failure.

This paper discusses a number of factors influencing the selection of the landing-gear control system and gives a summary of basic design principles that must be followed in order to achieve a reliable electrical landing-gear system.

Power-Supply Coordination

The first requirement for a reliable electrical landing-gear system is that of a reliable and adequate source of electrical power. Aircraft electrical power systems can be, and are being, designed in which the possibility of power-supply failure is remote. While the methods of design of such a system are beyond the scope of this paper, it is well to review briefly some of the principles that must be recognized both in providing a reliable source of power and in limiting the severity of the landing-gear operation on that system and the other equipment connected thereto.

Reliability

A reliable power-supply system must have more than a single source unit. In general, the greater the number of supply units, the lesser will be the effect of the failure of one or more units. It must be remembered that a unit of power supply must not be dependent on, or common with, any part of any other source unit. For example, two generators installed on one engine of a multi-engined airplane comprise a single source unit, since failure of the engine results in the loss of both generators.

That part of the power-supply distribution system which delivers power to essential loads, such as the landing gear, must consist of a multiple number of channels. This factor is of special importance on military aircraft where gunfire may sever distribution-system cables. With a single-channel distribution system a single severed cable will disrupt the electrical service to the area fed by that part of the distribution system. The use of two or more channels makes the possibility of service interruption comparatively remote, since both channels in the same distribution circuit would need to be interrupted.

In order to clear electrical faults promptly before they can adversely affect the power-supply system, all load circuits, power-supply circuits, and distribution circuits must be provided with circuit protective devices. These devices must be properly selected so that only the particular circuit faulted will be cleared. The protective function demands that the protective device have adequate interrupting rating as controlled by the capacity of the power-supply system.

Capacity

On military aircraft having high combat electrical loads the power-supply system is usually adequate for the landing gear if reasonable design care is exercised in the sequence of operation. On transport types of aircraft the landing gear may be the major electrical load and the character of the power-supply system will be determined chiefly by the nature of the landing-gear operation. In the design of a power-supply system the three performance characteristics that must be considered are (1) thermal capacity, (2) power stability, and (3) voltage dips.

The landing-gear load is usually of such short duration that it has little

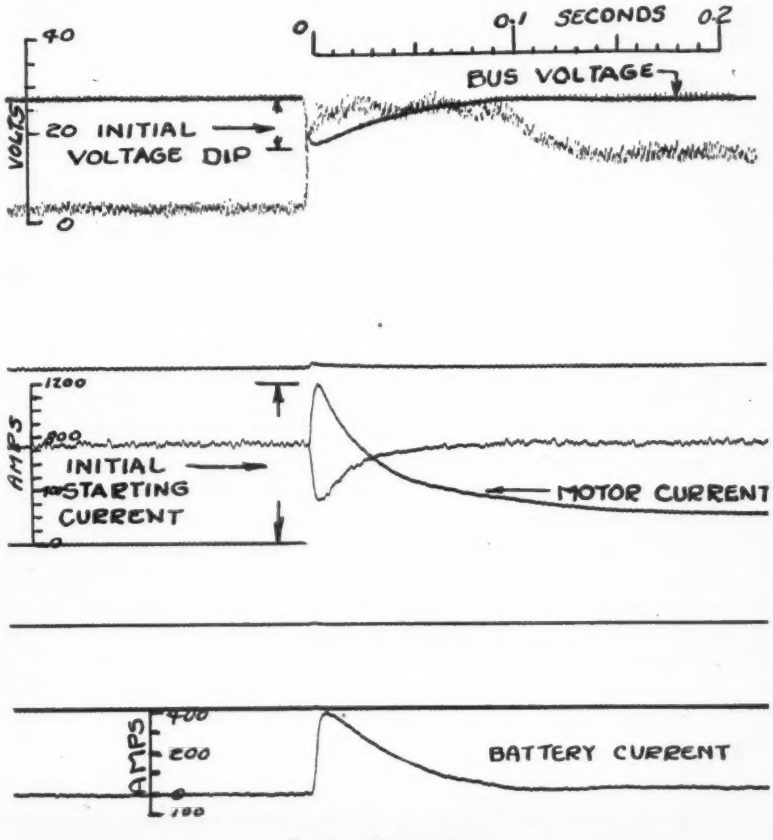


Fig. 1. Motor starting.

Presented at the National Fall Meeting, I.A.S., Dayton, Ohio, November 9–10, 1944.

* The material in this paper was compiled and presented while the author was an Electrical Engineer, Electrical Branch, Equipment Laboratory, Air Technical Service Command. He is at present associated with the Industrial Engineering Division of General Electric Company.

Better Control . . . .

OF HYDRAULIC POWER BRAKING

VICKERS AIRCRAFT
POWER BRAKE VALVES

These valves have true "hydraulic feel" . . . the resistance to brake pedal movement is hydraulic and directly proportioned to the pressure in the brake. In the event of pressure or brake failure, the pedal is depressed without appreciable force thus giving the pilot instant warning of pressure loss. The time interval between pedal movement and brake application (or release) is minimized thus giving the immediate brake action which eliminates the tendency to overbrake.

These valves have high efficiency and are uniform; the control obtained is smooth and constant. The valve input pressure may be as high as 1500 psi and control is obtained with pressure as low as 25 psi at the brake. Accurate control of braking is independent of pressure in main hydraulic system providing only that system pressure is equal to or greater than the pressure needed to provide maximum braking force.

VICKERS Incorporated
1414 OAKMAN BLVD.
DETROIT 32, MICHIGAN
•
Engineers and Builders of
Oil Hydraulic Equipment Since 1921

✱ *Boots removed from Double Valve to show plunger adjustment which makes installation easier.*

effect in establishing the thermal capacity of the power-supply source units. In some cases, where the operation of considerable other electrical equipment occurs during the period when the landing gear is normally operated, the thermal capacity may be influenced by the landing-gear operation. In these cases, the landing-gear operation will contribute to the root-mean-square value of current for that period.

Power stability of a power-supply system composed of main engine-driven generators may be particularly limited for landing operations if the engine speed is reduced prior to the lowering of the gear. Proper matching of the supply to the load characteristic may be accomplished in some cases by reduction in load by individual operation of the landing gear or, more generally, by an increase in the size or number of source units.

Inadequate system transient capacity for large motor starting results in excessive voltage dips during the motor-starting period. This may result in contactor welding or may adversely affect other electrically operated equipment. It is desirable to limit the voltage dip to 30 per cent of the normal system voltage, but in no case should voltage dips of more than 50 per cent be permitted. If the voltage dip is excessive, correction may be accomplished by increasing system transient capacity or limiting the starting current.

Batteries are a fairly satisfactory means of supplying additional transient capacity providing they are not required to operate at low temperatures. For low-temperature operation, generators are a better choice.

Starting currents may be limited by starting the motor units of multiple-motor landing gear individually. Since the acceleration of the landing-gear motors and the recovery of most present power systems are both extremely rapid, a delay between starting operations of only 0.1 sec. is usually adequate. Fig. 1 shows a typical recovery of system voltage following application of a heavy retracting motor load. Where the starting of a single-motor unit results in excessive initial voltage dip, a resistance or reduced voltage motor starting controller should be used.

Motor Control Circuit

Fig. 2 shows a typical control circuit for a landing-gear actuating unit. The extension or retraction process is initiated by closing the control switch at the pilot's station to energize the motor contactor through the normally closed limit switch. When the operation is complete, the limit switch operates to

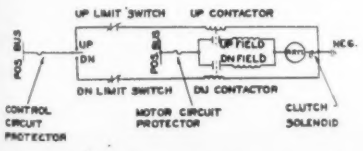


Fig. 2. Typical retraction—motor circuit.

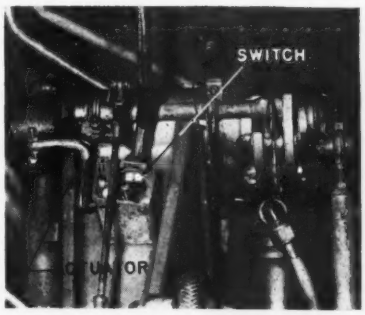


Fig. 3. Limit switch and actuator.

de-energize the contactor, allowing it to open and de-energize the motor. The motor unit usually has a solenoid-operated clutch that disengages the motor as soon as the motor is de-energized.

The component equipment in the motor control circuit requires individual consideration in obtaining products of proper operating characteristics and having high quality consistent with that of the remainder of the landing-gear system.

Contactor Application

Of major concern in the selection of the contactor is its ability to withstand successfully the motor-starting inrush current at the minimum voltage likely to be experienced. The misapplication of contactors with resulting contact welding has been a frequent source of trouble. Newly developed contactors have the proper design to give satisfactory operation at minimum transient voltages down to 30 per cent of normal voltage and are designed to eliminate contact bounce. These contactors give completely reliable service where they are not subjected to use on systems of inadequate transient capacity or where motor plugging (which will be discussed later) is permitted.

Contactors must be capable of interrupting full-voltage starting current of the controlled motor. The contactor may be de-energized during the initial inrush, either as a result of the desire of the operator or as a result of a faulty control switch.

Mechanical interlock of the up-and-down contactors is desirable to prevent energizing of the two motor fields simultaneously to operate the motor in opposite directions. This could occur during incorrect maintenance checks or possibly from sticking or welding of a contactor during operation with inadequate power supply. The interlock can then prevent a needless motor failure. Moreover, with a stuck or welded contactor, the force from the opposite contactor is frequently sufficient to free the stuck or welded contactor.

Limit-Switch Application

The major problem in the limit-switch control is the design of the limit-switch actuator—its arrangement and adjustment so that the screw mechanism is stopped at exactly the correct position. There is a need for considerable engineering work on the functional design problems of the limit switch and its actuator. Many of the actuators now in use are cheaply constructed and do not represent a particularly high degree of design perfection (see Fig. 3).

Problems of limit-switch adjustment can be improved if some means of turning the landing-gear screw by hand are provided. When manual emergency operation of the gear is used this is automatically provided. When electrical emergency operation is used provisions for connecting a hand crank during adjustment are desirable.

Best operation will be obtained if the design of the landing-gear mechanism is such as to provide a range in acceptable terminal position. Operation of the limit switch should occur as the mechanism first enters the acceptable zone. The maximum overtravel should not

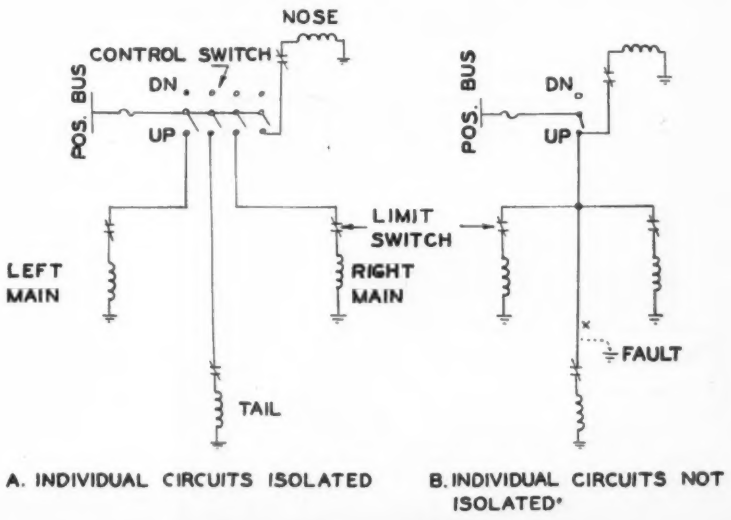
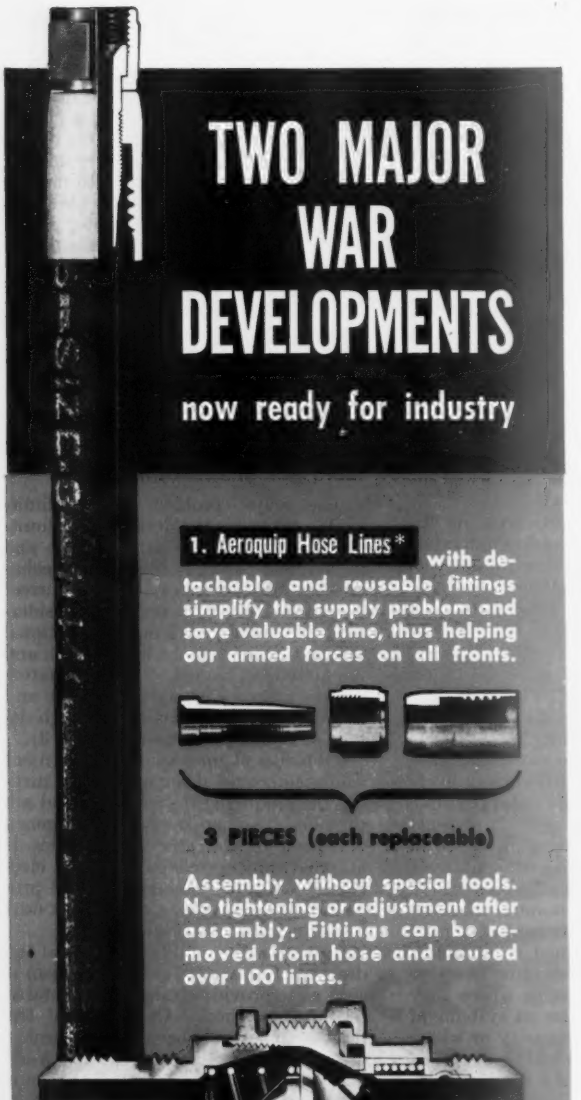


Fig. 4. Contactor control circuits.


TWO MAJOR WAR DEVELOPMENTS
now ready for industry
1. Aeroquip Hose Lines* with detachable and reusable fittings simplify the supply problem and save valuable time, thus helping our armed forces on all fronts.
3 PIECES (each replaceable)
Assembly without special tools. No tightening or adjustment after assembly. Fittings can be removed from hose and reused over 100 times.
2. Aeroquip Self Sealing Couplings* allow disconnection of liquid carrying lines without loss of fluid and reconnection without inclusion of air.
*STANDARD EQUIPMENT ON U. S. ARMY AND NAVY COMBAT AIRCRAFT
AEROQUIP CORPORATION
JACKSON, MICHIGAN, U. S. A.

WHEEL and BRAKE CHANGING TIME CUT 10 to 1

Reports on Self-sealing Couplings reveal large savings... Bleeding time eliminated.

Reductions in wheel and brake changing time of as much as 10 to 1 are reported on aircraft installations by the use of Aeroquip Self-sealing Couplings.

Aeroquip Self-sealing Coupling and Hose Line with Detachable Fittings installed on Hayes Wheel and Expander Tube Brakes

These couplings, whose instant sealing feature permits quick disconnection of hydraulic lines without loss of fluid and reconnection without admission of air, have changed the maintenance problems of hydraulic systems. Not only on wheel and brake changes, but also on all other fluid connections where disconnecting and reconnecting operations had created time-consuming problems of draining, refilling and bleeding, Aeroquip Self-sealing Couplings have introduced new elements of efficiency and economy.

Reports of comparable installations cite such time reductions on wheel and brake changes as from 75 minutes to 7½ minutes, after equipping with self-sealing couplings.

These couplings and Aeroquip Hose Lines with Detachable Fittings present an effective combination for efficient hydraulic system performance. The hose line fittings, all parts of which are replaceable individually, are readily removed and reused on new lines which can be cut to any desired lengths and installed on the job.

It is predicted that these Aeroquip Self-sealing Couplings, Hose Lines and Detachable Fittings, now in rugged use on military and naval aircraft around the world, will have extensive applications to machinery and other products in post-war design.

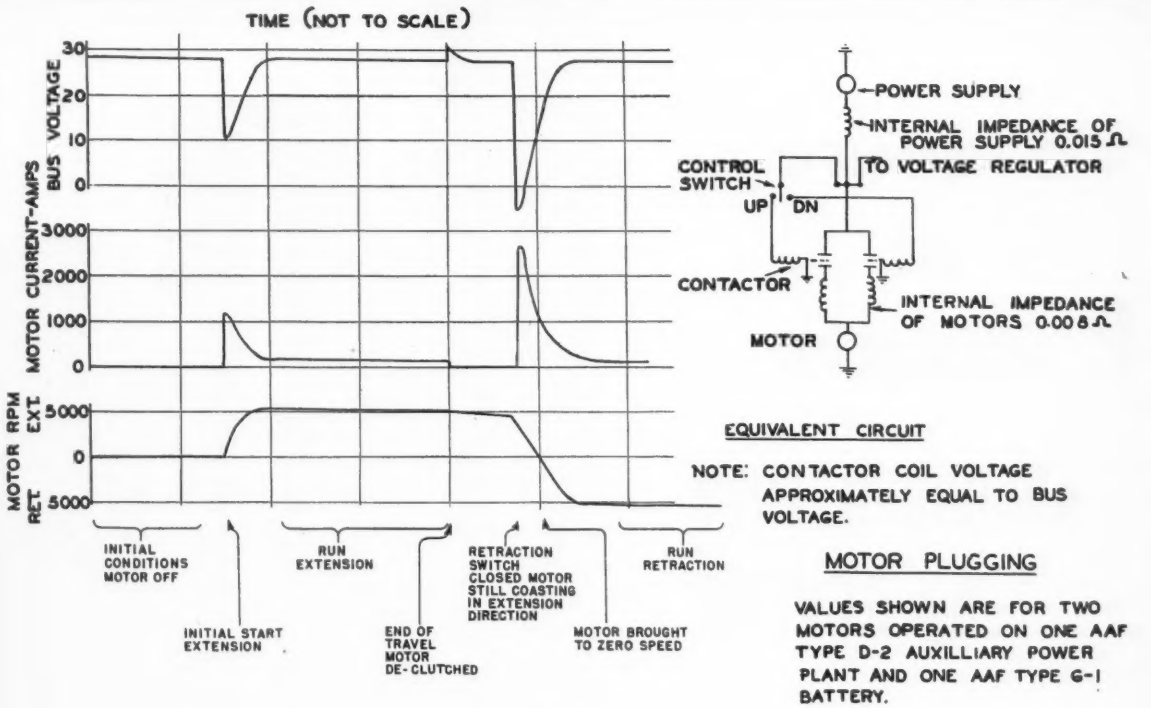


Fig. 5.

propel it beyond the end of the acceptable zone.

Control Circuit Isolation

Each individual motor contactor control circuit can be connected to a separate control switch as shown in Fig. 4a. This circuit has the following advantages:

(1) A fault on any circuit affects only that particular circuit.

(2) Accidentally energizing any circuit from a point other than the control switch does not energize the remaining circuits.

(3) Individual operation of the gear is possible.

(4) The circuit is easier to understand.

(5) Trouble shooting is easier.

With the nonisolated circuits such as are shown in Fig. 4b a fault on any circuit, such as Point X, results in operation of the circuit protective device so that all of the circuits are made inoperative. This can be prevented by carrying each control circuit to the control station and by using as many protective devices as there are circuits. If the protective device is not of the resettable type, individual protectors will be required for each of the circuits even though they are isolated.

Where one of the landing-gear units is a tail skid or tail wheel, retraction of that unit without jacking or with only partial jacking up of the airplane is possible. In a number of instances the contactor of such a unit has been energized locally to retract that particular unit. Since, for the nonisolated circuit (Fig. 4b), the tail-skid circuit was connected with the other landing gear circuits, retraction of all units resulted. In one case, the energizing of the common circuits is believed to have resulted from surface leakage across insulation following exposure to rain and dirt.

By the use of individual circuits each circuit is a unit within itself. This breakdown of the overall circuit permits easier understanding by operating and maintenance personnel. Since each circuit is isolated, it can be examined individually without concern as to paths through adjacent circuits during trouble shooting.

While individual operation of the landing gear is normally not desirable, on some airplanes there is considerable weight-saving in power-supply equipment to do this. When simultaneous operation of the gear is considered essential, the individual control switches may be combined to form a multiple-pole switch or individual switches may be tied together by some other mechanical arrangement. If such a tie is used it should be readily removable to permit individual operation of the gear on ground maintenance checks.

Motor Plugging

When the drive motor is switched off by either control or limit-switch operation, it continues to rotate for perhaps 10 sec. If, during this interval, the motor is energized to operate in the opposite direction, a voltage is generated within the motor with polarity opposite to that normally present. The motor thus tends to establish a terminal voltage opposite in polarity to that of the power supply. With limited power-supply capacity, the tendency may be sufficient to cause the bus voltage (and contactor voltage) to drop to zero or reverse its polarity. Under all conditions of power supply the voltage dip is aggravated by the motor plugging, and the current magnitude through the motor will be substantially higher than for a normal starting operation.

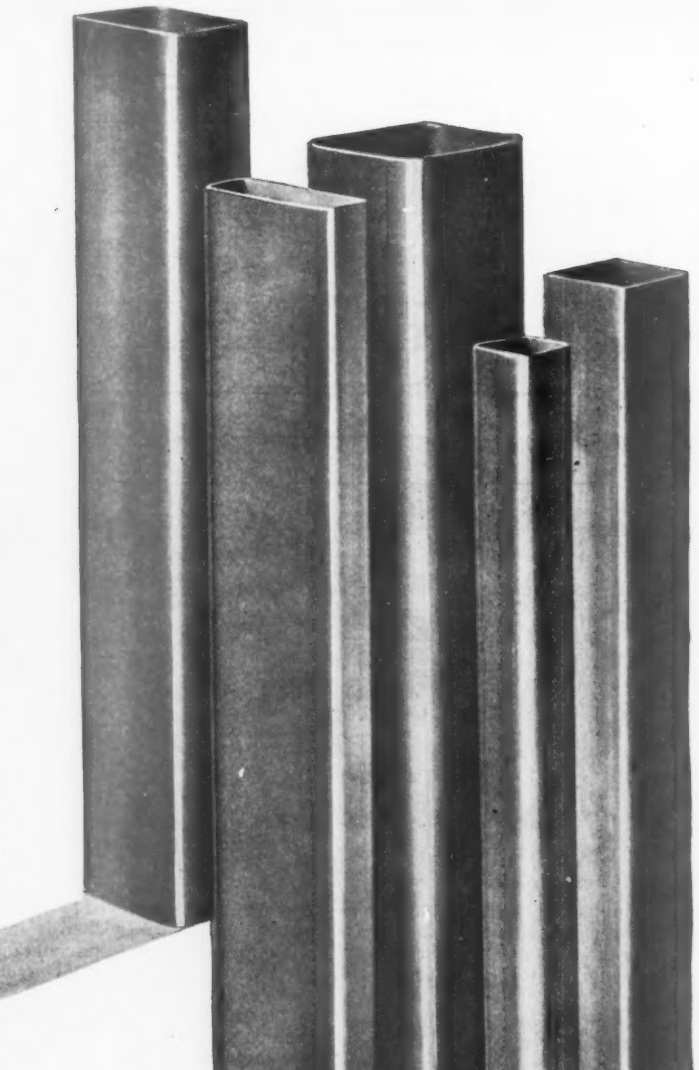
A typical sequence of operation during motor plugging is illustrated in Fig. 5. The values of current and voltage given are based on oscillographic records of an actual operation.

Motor plugging usually results in: (1) contactor failure (welding); (2) flashing across of motor armature. In addition, high values of torque are generated and must be absorbed by acceleration of the motor and screw mechanisms. Excessive stresses in mechanical members may result.

Plugging of the motor can be prevented by waiting until the motor speed has decreased to a low value before reversal of the motor. The necessary period of delay may range from 2 to 5 sec. The delay, to be reliable, should not be dependent on the operator. Any automatic method of obtaining a time delay of 2 to 5 sec. is either heavy or uses troublesome dashpots. Further, it is conceivable that reversal in less time might be desirable in some cases.

Any means of braking the motor can be effective in reducing the delay period. Dynamic braking can be used but it complicates the control circuit. A mechanical brake on the motor rotor, released when the motor is de-energized, is fast and fairly simple.

Square and Rectangular Aluminum Tube ...by REVERE



Do you know that —

Revere makes other than round aluminum alloy tubes.

The quality and service established by Revere on round tubes is now available in square and rectangular shapes.

These tubes are now used chiefly in aircraft structural members. They combine lightness with strength and rigidity.

Square and rectangular tubes are drawn from round to provide physical properties that meet specifications for either the S-O (soft) or the S-T (heat-treated) condition.

Dies are available for a wide range of sizes and shapes. New designs may be created to meet new engineering needs.

Eventually, when metal and facilities exceed the needs of war, these tubes will have many important uses in products for civilians. Remember Revere's extensive experience in working aluminum to the most exacting military standards when planning for the future. For full information, write Revere Executive Offices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N.Y.

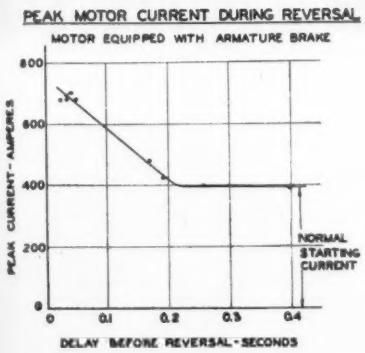


Fig. 6.

Fig. 6 gives the results of tests conducted on a retraction motor using a mechanical brake. A normal aircraft type double-throw toggle switch controlled motor contactor operation. It can be seen that reversal of the motor was possible in as short a time as 0.025 sec., but that an 0.2-sec. delay was required to reduce the speed sufficiently to prevent surges in excess of the motor starting current.

Thus, even with a mechanical brake some additional delay over that provided by the switching process, including contactor closing, is necessary. The additional delay can be accomplished by time-delay relays, but the resulting circuit is complex. A switch requiring momentary delay in the "off" position is needed for this application. Such switches have been commercially used but have not yet been adapted to aircraft service.

Control Switch

The features of (1) circuit isolation, (2) prevention of motor plugging, (3) individual starting of motors, and (4) individual operation of motors during maintenance checks could be readily accomplished without complication of control circuits if a switch having the following characteristics were developed:

(1) Three poles double throw (four poles for some applications).

(2) Normal operation of all three poles by one operator action with provision for operating each individually.

(3) Delay of 0.2 sec. in "off" position during reversal.

(4) One pole to close at the time the control operating lever is actuated. The remaining poles to close at 0.1-sec. intervals.

Ground Retraction

Accidental retraction of the landing gear while the airplane is on the ground results, usually, from accidental energizing of the contactor control circuits. In some cases, it is the result of contactor failure, but this occurs only when the failure is followed by extremely poor maintenance procedures.

Retraction Blocking Switches

Any change in condition between ground and flight operation may be used to actuate protective switches in the motor-contactor coil circuits so that retraction can occur only when the airplane is in flight. Conditions that change between ground and flight operation are: (1) airplane weight removed from the landing gear, (2) airplane weight supported by wings, and (3) air speed.

All of these influences are not exactly defined during the transitional stage at take-off. The exact condition is greatly dependent upon the airplane load and attitude. The general limitation of the use of such safety switches is that it gives the pilot an opportunity to close the control switch prior to take-off and permits the gear to retract automatically when the proper flight condition is obtained to close the safety switches. Accidents may occur if the airplane is not definitely air borne.

Combinations of the functions outlined above might be worked out so that the reliability of determining whether the airplane is definitely air borne would be such that it could be used advantageously for automatically initiating the retraction process at the earliest possible time without manual attention.

Experience has convincingly demonstrated the need for some type of ground safety switches to block retraction operation when the airplane is on the ground.

Strut Safety Switches

The use of safety switches actuated by the movement of the landing gear strut is illustrated in Fig. 7. The mechanical arrangement should be such that the effect of variations in position without weight on the gear, such as normally occur in service, will influence the actuation of the switch as little as possible.

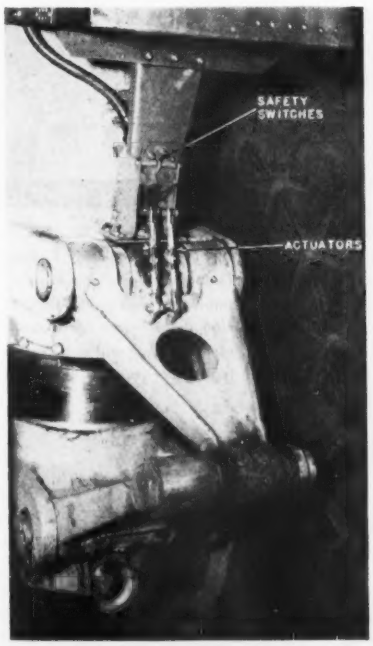


Fig. 7. Safety strut switch.

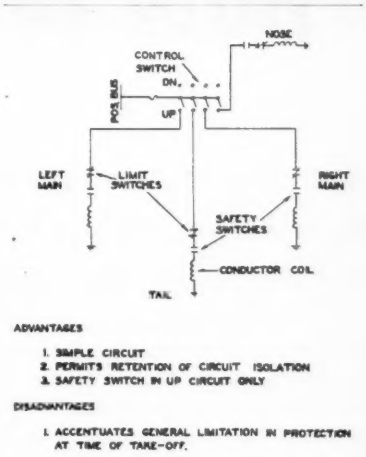


Fig. 8. Circuit for individual safety switches.

Safety Switch Circuits

There are several circuit arrangements that may be used to incorporate safety switches. The circuit used should be the simplest one that will give the required degree of reliability. Since the safety switches are to prevent accidental retraction, it is not necessary that they be included in the extension circuit. In fact, the extension circuit should not be complicated with the safety switch, since it would then offer one additional part that might fail and prevent extension of the gear.

The advantages to be gained in the simplicity and ease of maintenance circuit checks accruing from the isolation of individual landing-gear circuits should be retained, if possible.

Fig. 8 shows one circuit that has been used successfully. The circuit does possess the general limitation in protection at take-off in that any gear can retract even though it is the only one off the ground (providing the control switch is closed). In spite of this limitation, it is believed that the advantage of simplicity and the fact that the switches are in the "up" circuit only are good reasons for use of the circuit.

Additional possible circuit arrangements are shown in Fig. 9.

If an electrical emergency system is used and has provisions for retracting the gear, strut safety switches would also have to be placed in the emergency contactor coil circuits.

Landing Gear Locks

In spite of safety circuits and good maintenance procedures, it is always possible that ground retractions may occur. Any of the protective features may be accidentally shorted, with resulting retraction if the circuit is energized. As a final safety precaution the use of mechanical locks or pins on the landing-gear mechanism appears desirable. While a spring-actuated lock with either a solenoid or mechanical release would be convenient for operation, it appears unnecessarily complex. The addition of mechanical locks as part of

How to choose the right tire for

B. F. Goodrich service to designers offers engineering help in choosing best tire for any airplane

THE SELECTION of the right airplane tire for the job affects airplane design in many ways. For example, tires with higher pressures can be smaller, more compact for the load they will carry. Or, consideration of the extra safety factor through the use of duals in some types of service may be vital, while in others the greater braking surface provided by a smooth-contour design may be the answer.

B. F. Goodrich Low Pressure evolves into new Type III

All the factors of airplane tire design have grown to the point that it is no longer possible to draw the line between tire types by referring to high pressure, low pressure types. The first "low pressure" tire for airplanes was engineered by B. F. Goodrich. It remains today probably the most efficient type of tire for general air transport and cargo service. But some sizes carry comparatively higher pressures today. The distinguishing characteristics of the tire are its superior wear life, cushioning and safety. So the new designation, Type III, has been established as representing these general features.

Other types

Other types of tires are specially designed for different tire uses. Shown on this page are cross sections of the three most important types, with a general outline of their characteristics.

Full facts in new catalog . . . **Latest edition of The B. F. Goodrich Aeronautical Products Catalog contains complete tire data—sizes, types, characteristics, etc. Also helpful facts on De-icers, fuel cells, brakes, hose and many other rubber products for aircraft. For your copy, write to The B. F. Goodrich Company, Aeronautical Division, Dept. F6, Akron, Ohio.**

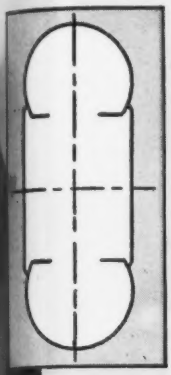
BOEING SUPERFORTRESS lands on four 56" B. F. Goodrich Silvertowns, Type I (smooth contour). Made of synthetic rubber reinforced with nylon, these Type I's are designed for heavy load carrying per pound of tire. Large wheel diameters provide the high brake capacity needed.

Skyway or Highway

B.F.Goodrich

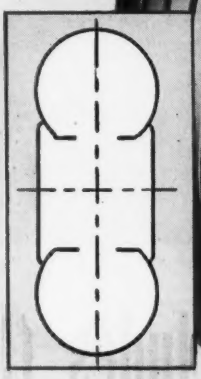
FIRST IN RUBBER

re for new airplane designs . . .



TYPE I
(Smooth contour)

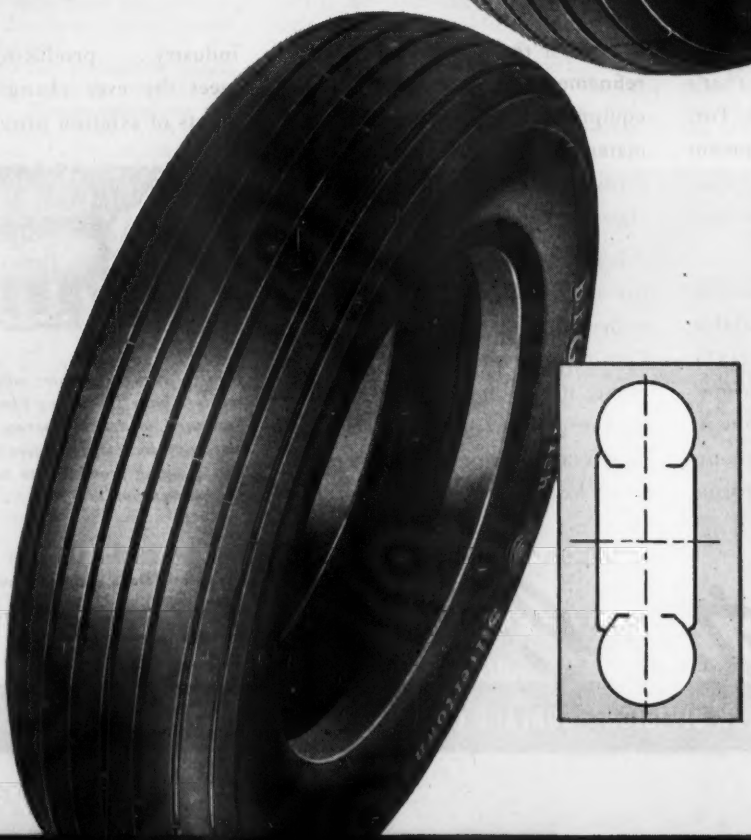
Good aerodynamic efficiency (where that is a factor) plus good load capacity per pound of tires. Provides sufficient wheel diameter for extra brake capacity. Wheel weights are high as compared to other types, and this type cannot be used on thin wing planes where retracting space is limited. Type I tailwheels, because they do not require brakes, have relatively smaller wheel diameters.



TYPE III (Low pressure)

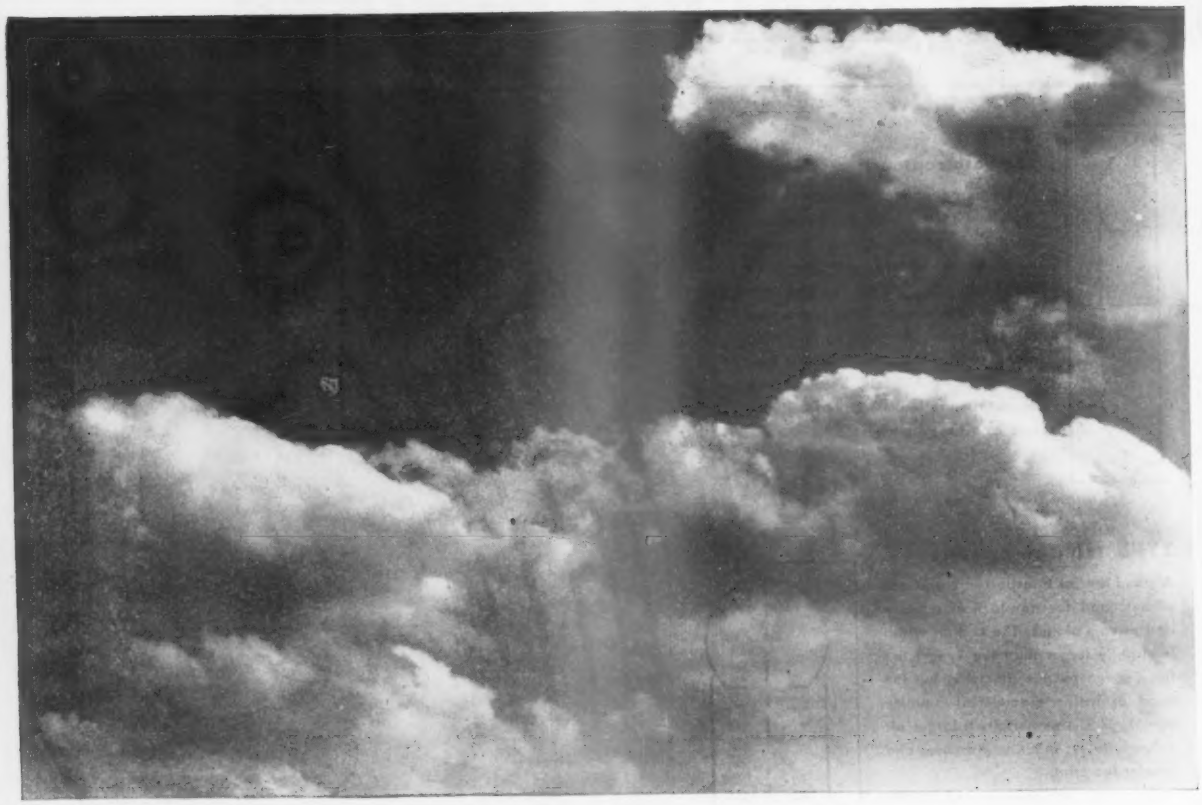
A good tire for transport or cargo airplanes, and for non-tactical military and private planes. The section width is slightly larger than the Type I tire for a given outside diameter, but the bead or inside diameter is smaller than Type I. This permits a larger air volume, lower inflation pressures and greater footprint.

For wear, cushioning and safety, Type III tires are generally superior. For comparable outside diameters, they will generally weigh more than the Type I, but the smaller wheel diameters will compensate for this increase in weight.



TYPE VII
(Extra high pressure)

Recommended as most efficient for most tactical military planes, when performance in the air is the prime consideration. Designed to provide a tire with a very high load capacity for its size and weight plus a narrower section width to permit retraction into latest design thin wings.

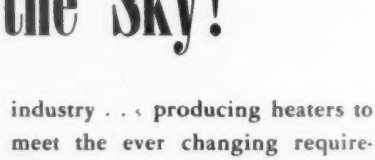


Our Laboratory Includes the Sky!

Wherever planes are flying with Janitrol Aircraft Heaters, *that's where part of our laboratory is.* For, we regard the study of equipment under *actual operating conditions* as a highly important part of Janitrol research.

Equipped with the most modern scientific testing apparatus available —Surface Combustion engineers fly in many types of United Nations' planes in every part of the globe to gather *first hand,* operating data on Janitrol Aircraft Heater performance. On the basis of this data, refinements in design and control equipment are made possible, and materials are evaluated as to performance characteristics under the rigors of wartime flying.

It's this type of continuous follow-up work in the field, combined with extensive research in Surface Combustion laboratories here at home, that is helping us to carry out our aim of *constant development* in aircraft heating. And to enable us to keep pace with the aircraft industry . . . producing heaters to meet the ever changing requirements of aviation progress.



Janitrol Aircraft Heater which utilizes the revolutionary "Whirling Flame" principle Standard models to operate with ram or blower recirculated air give heating capacities ranging from 15,000 to 185,000 Btu per hour output.

Janitrol

JANITROL Manufacturing Plants at: Toledo and Columbus, Ohio.
Engineering Offices at New York, Chicago, Los Angeles, San Francisco and other principal cities

AIRCRAFT HEATER DIVISION • SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

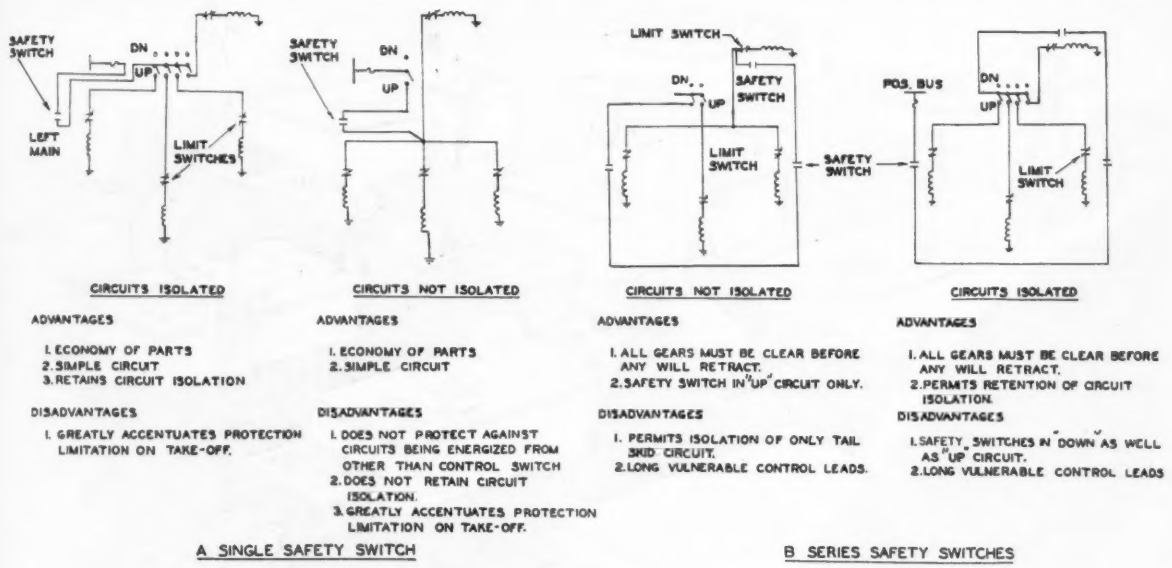


Fig. 9. Alternate safety-switch circuits.

the ground equipment, to be used at all times that the airplane is on the ground, is simpler and more positive but requires definite operating procedures. Fig. 10 shows one such arrangement of locks.

Emergency Systems

While with a well-designed and properly maintained electrically actuated landing-gear system there will be few failures to extend the gear in flight (except for battle damage on military aircraft), service experience has emphasized the need for an emergency means of extending the gear.

In addition, a fast emergency means of retracting the gear is desirable on some aircraft. Where operations are carried out at heavy loads from small fields, a high rate of climb at take-off is essential. Failure to retract the gear, especially in case of an engine failure on take-off, may result in stalling. An emergency retraction system comparable to the normal system in speed of operation, arranged for immediate operation when it is evident that the normal system is inoperative, is a desirable feature.

Where only emergency extension is required a mechanical method depending on gravity following manual release or on a manual crank is satisfactory, providing sufficiently high breakaway torque can be applied. Where emergency retraction as well is considered, the electrical method is advantageous. Other definite advantages of the electrical system over the mechanical systems are: (1) It is easier to fit into airplane design than are a torque tube and hand crank. (2) It has high breakaway torques. (3) In many applications it is lighter. (4) Weight investment in improved electrical power reliability benefits other equipment as well.

One application of an electrical emergency landing-gear system is shown schematically in Fig. 11. Because of failure to recognize the fundamental principle of an emergency system—*that it must be completely independent of the normal system*—this application was not especially successful until modifications were made in the control circuits.

In the particular application shown the power supply and actuating motor did conform to the fundamental principle, but the normal and emergency control systems had the same limit-switch actuator, the limit switches were directly adjacent to each other in a common housing, and the cables were in common bundles and connected through the same electrical connectors. In at least two cases both the normal and emergency systems were prevented from operating by a small screw becoming lodged under the common limit-switch actuator.

In the same application, during emergency operation each gear was successively operated by means of a transfer switch on the previous gear in order to limit the load on the emergency power-supply system. This arrangement effectively combined the operation as though it were a single one having large vulnerable area. Individual control switches are a better arrangement.

The best emergency system is one having a minimum amount of complication in its control circuit. This principle should be achieved even at the expense of requiring maintenance following use of the emergency system. Since the actuating motors are usually pro-

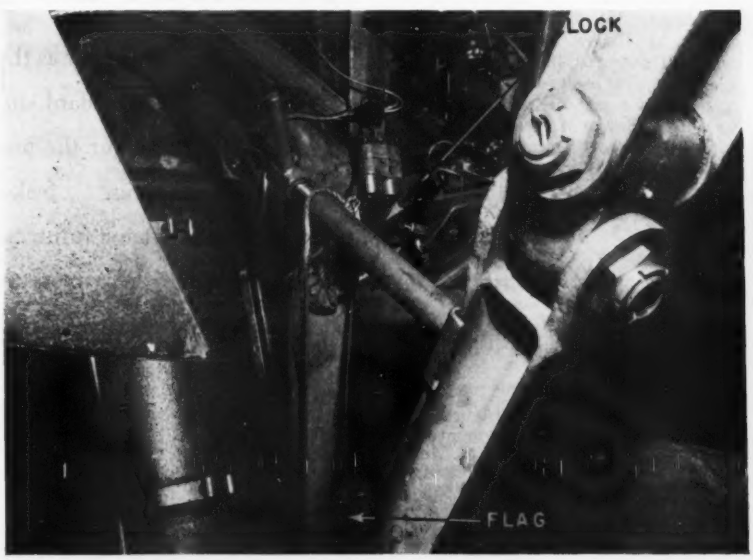
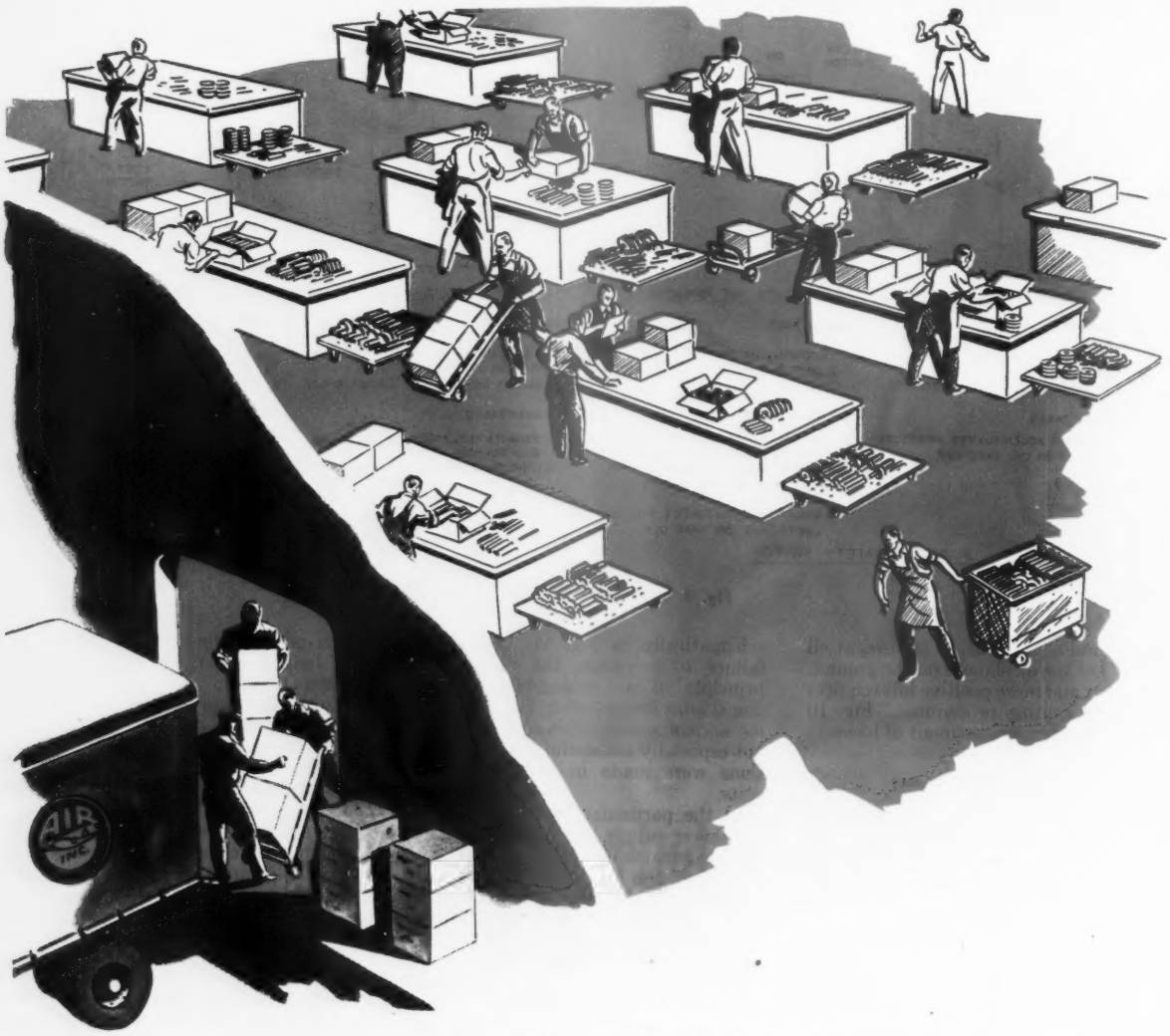


Fig. 10. Mechanical locks.



Aviation's Largest Stockroom . . .

Eighteen years experience as the aircraft industry's dependable "general store" for off-the-shelf standard supplies and equipment . . . plus warborn knowledge and facilities for the production of specialty accessories of our own design and engineering . . . make Air Associates the logical supply source for meeting the current and future needs of private, commercial and military aviation . . . Today, with four strategically located offices and warehouses, efficiently staffed and adequately stocked with thousands of items, from cotter pins to intricate test stand apparatus—remember . . . no order is too small or too large to get prompt attention at proper prices!

• **AIR ASSOCIATES, INC.**

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . .
ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . .
SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

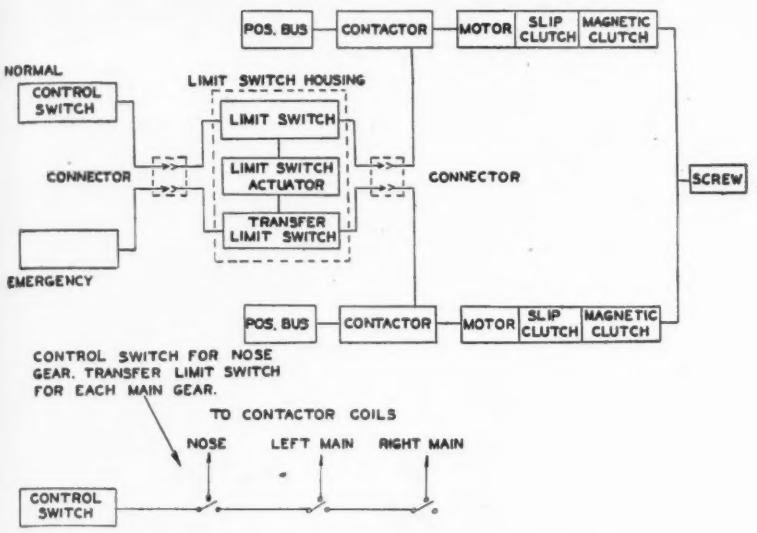


Fig. 11. Normal and emergency motor control circuits.

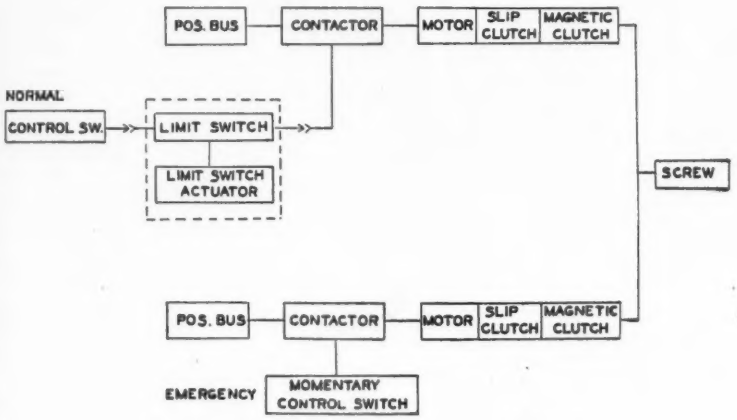


Fig. 12. Simplified emergency motor control circuit.

vided with either an overload slip-clutch or torque release, serious damage will not result from a short period of operation even if the motor is not turned off at the end of gear travel. Such a system is illustrated in Fig. 12.

It is particularly important that the operating procedure for an emergency system be simple and self-evident. The fact that it is rarely used, and then only under stress and excitement, should convincingly justify this objective.

Warning Systems

A supervisory system that indicates the position of the landing gear is a desirable feature and, if properly designed reduces the number of operating errors. In its most generally accepted form this system consists of indicator lights and an audible warning signal controlled by limit switches on the landing-gear actuating mechanism and by switches on the throttles.

The present requirements of the Army Air Forces for the warning system are given in Fig. 13. A supervisory system meeting these requirements has a complete cross check on itself. The greatest disadvantage of the requirements is the complexity of the circuit necessary for their accomplishment.

The function of the audible warning should be to call attention to an unsafe landing condition. The indicator lights define the nature of those unsafe conditions. When the throttle and landing-gear switches set up a closed circuit to indicate an unsafe landing condition, the indicator lights and audible warning should be switched on. In calling attention to the unsafe condition the audible warning has completed its function and the arrangement should be such that the operator may silence it if he desires. This may be desirable if one engine only is operated with a retracted throttle position in flight or in making a long glide with throttles retarded. The indicator lights should not be affected by silencing the horn. In addition, the audible warning should be switched on again by any new signal from the throttle and landing-gear switches.

The reliability of the warning system can be judged by the reliability of the means used to give the warning circuit knowledge of an approaching landing. While actuation of switches by retarding the throttles has been the most commonly used method, it must be recognized that is not infallible.

Regardless of the particular circuit used for the warning system, it will be a reliable indicator of the position of the landing gear only if it is completely independent of the actuating circuits. For example, some installations have a limit-switch actuator common to both the actuating controls and the warning system. The warning system then indicates the operation of the normal control circuit and not necessarily the position of the landing gear. If the actuator is out of adjustment the control limit switch may switch off the drive motor prematurely. But, since the warning circuit switch is also simultaneously operated, the warning system will indicate the gear to be down and locked.

Organization of Controls

All controls and warning signals needed for operation should be organized in such a manner that the correct method of operation is suggested. While physical separation of the emergency and normal systems is necessary to eliminate common points of vulnerability, the physical separation of the interdependent parts of one system results only in an increase in vulnerable area and increased difficulty in operation and maintenance. The example of control locations, Fig. 14, illustrates an installation in which better organization could be achieved. Too many landing-gear accidents result from operating errors. It is believed that careful organization of the controls could reduce that number.

Overhauling Loads

The mechanical arrangement of many landing gears is such that during part of the extension the weight or wind-pressure is sufficient to cause lowering of the gear. If the speed is limited only by friction losses in the screw, gears, and bearings, the rate of extension may be sufficiently rapid to cause excessive motor speeds. There are a number of solutions to the problem of overhauling loads:

GEAR POSITION	THROTTLE POS. FORWARD	THROTTLE POS. RETARDED	HORN	RED LIGHT	GREEN LIGHT
UP AND LOCKED	●				
		●	●	●	
ANY INTERMEDIATE POSITION	●			●	
		●	●	●	
DOWN AND LOCKED	●				●
		●			●

Fig. 13. Landing-gear warning system A.A.F. requirements.

AN IMPORTANT DEVELOPMENT for fighter pilots is this new Kollsman Maximum Allowable Airspeed Indicator. The broad colored pointer moving over the dial of the indicator gives the pilot constant warning of the airspeed at which the plane will enter the dangerous compressibility pattern. This is a speed which may be quickly reached in flight maneuvers, particularly at high altitudes, with resulting loss of control or destruction of the aircraft. Operating airspeed is indicated by means of the white pointer on the same dial. The relationship of operating airspeed to the critical speed is, therefore, constantly apparent. On the mechanism which actuates the colored pointer, settings are provided for both the maximum desirable Mach Number and the maximum operational speed for the particular design of aircraft being flown.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

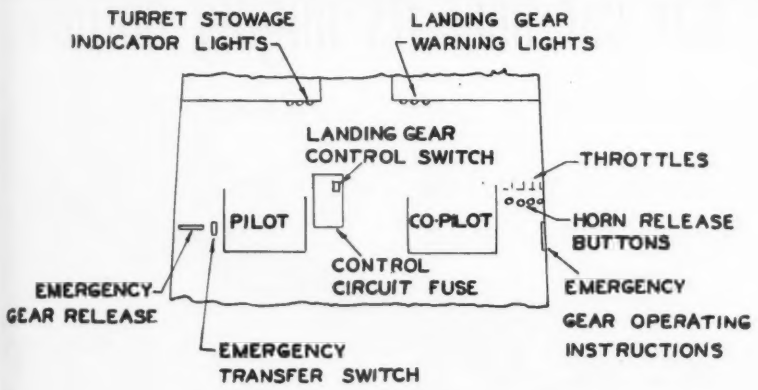


Fig. 14. Disorganized landing-gear controls.

(1) Design the motor to withstand extremely high overspeeds. Such a motor design is difficult and may require use of closed slot armatures, strong commutators, and sealed bearings. Reduction gears must also be designed to withstand high speeds.

(2) Use a centrifugally actuated brake. This method appears to have considerable advantage but it complicates the construction of the motor units.

(3) Use regenerative or dynamic braking. This method utilizes braking forces developed by electrical output from the motor.

Regenerative braking can be accomplished by the use of a shunt field or by separate excitation applied to the series field with the armature connected to the line. A method of speed control that is essentially regenerative braking (proposed by R. H. Kaufmann of General Electric Company) utilizes a magnetic field structure of high retentivity. By this means, even at low currents, the magnetic field is inherently sustained at a substantial value of the same direction as injected by the initial starting current surge.

Dynamic braking can be accomplished by the application of separate excitation to the field with the armature loaded by a resistor. A common method of applying this principle to series motors is known as armature shunting, which involves the connection of a resistor in shunt with the armature.

Landing Gear Electrical Protection

Two types of protection must be considered on landing gear applications:—motor (thermal) and fault. Motor-thermal protection should be used to assure maximum utilization of the motor ability under adverse operating conditions. If a motor is called upon to deliver torques in excess of its normal amount for long periods, overheating of the motor results, so that the maximum torque the motor can deliver is reduced (because of the elevated temperature) and there is danger of complete motor failure. The operator rarely has sufficient knowledge of the motor ability or operating conditions to decide when the motor should be switched off to cool before another trial. A motor-thermal protector has exact knowledge of the motor ability and will allow it to continue to deliver to its maximum ability. It does little good to overheat and burn out a motor if, in the process, less useful output is obtained than would be obtained by operating the motor at its maximum output followed by a rest period.

If the motor-thermal protector automatically resets following its operation, some arrangement should be made to indicate to the operator that it has operated. In one case of application of a thermally protected motor the limit switch was out of adjustment. The motor continued to be intermittently energized after reaching the mechanical travel limit. Since there was no indication that the protector had operated, the faulty limit-switch adjustment was not detected and continued application of this abnormal service ultimately resulted in motor failure.

Fault protection is concerned with the following: (1) divorcing a faulted circuit from the system before it can adversely affect the operation of that system; (2) preventing damage and fire.

The fault protector may not provide thermal protection for the motor although, where possible, it is advantageous for both features to be incorporated in a single device. Kaufmann[1] has outlined the principles to be followed in motor circuit protection, which, in general, call for interrupting current in excess of those demanded by a motor in normal or abnormal (blocked rotor) operation.

Operating and Maintenance Procedures

In spite of careful design of the landing-gear system, accidents will still occur unless satisfactory operating and maintenance procedures are followed. Definite programs of maintenance must be established with detailed formal step-by-step procedures followed for: (1) periodic inspection; (2) periodic functional tests, including adjustment of limit switches; and (3) inspection, repair, and functional tests of complete system following use of emergency system.

The following safety procedures are considered essential:

(1) Pins or locks should be used on the landing gear at all times when the airplane is on the ground.

(2) At any time that *any* work is being accomplished on any of the landing-gear units or circuits the airplane should be jacked clear of the ground. (This rule should never be deviated from, even though the operating or maintenance personnel are positive that the particular work being accomplished will not result in accidental retraction of the gear.)

(3) It is desirable that only one maintenance crew be working on an airplane at any one time. Where more than one crew is working, exact authority and responsibility for the energizing of any circuits must be given to one individual.

(4) Following any work on the landing-gear system, regardless of how minor the work may be, a complete functional test should be made.

Conclusions

The material presented in this paper can be summarized in the form of statements that can be effectively used as design criteria for electrical landing-gear systems:

(1) The power supply must be reliable.

(2) The power supply must be adequate.

(3) Limit switches must have design standards comparable with the importance of their function.

(4) Individual motor control circuits must be isolated.

(5) Plugging of motors must be prevented.

(6) Safety switches must be used to prevent ground retractions.

(7) Landing-gear mechanical locks should be used.

(8) The emergency system must be completely independent of the normal system.

(9) The emergency system must have the simplest possible arrangement.

(10) Warning systems must be independent of operating systems.

(11) Care must be exercised to prevent adverse effects from overhauling loads.

(12) Both fault and thermal protection should be used.

(13) Operation of the thermal protector should be positively indicated.

(14) Controls and warning systems must be organized so that methods of operation are suggested.

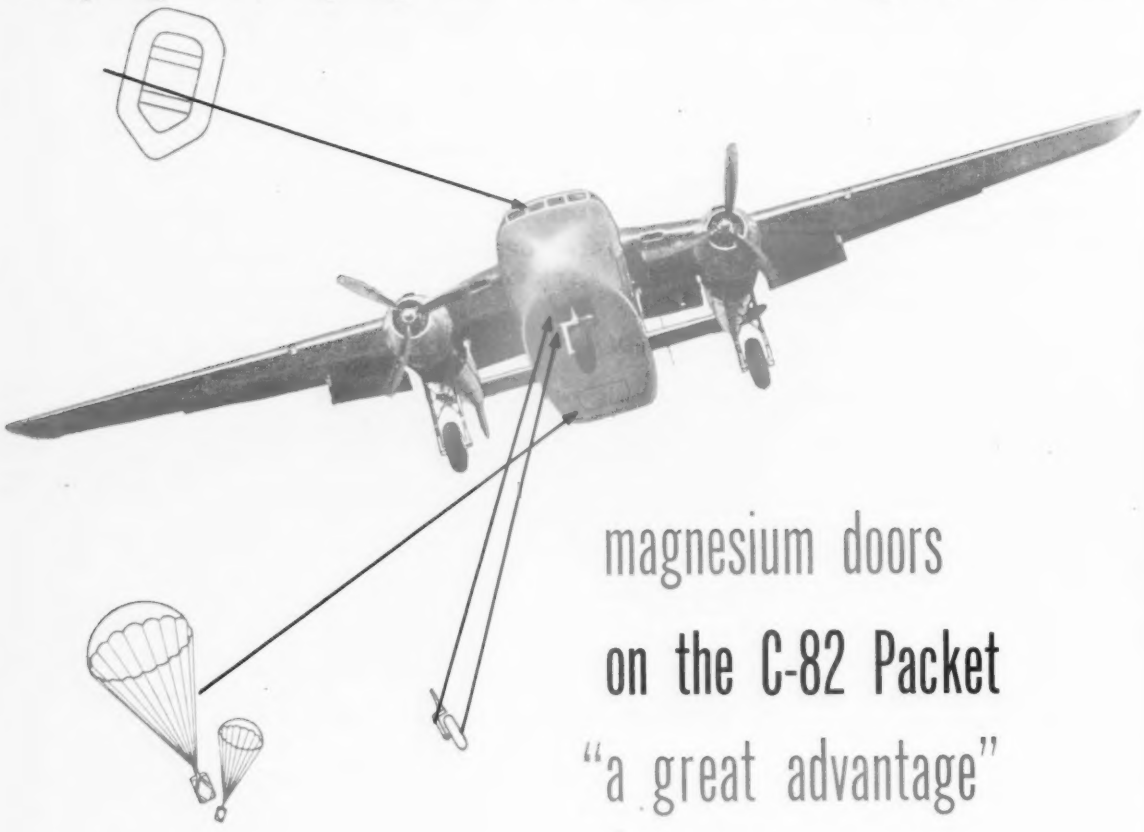
(15) Definite formal operating and maintenance safety procedures must be adopted and strictly exercised.

Acknowledgments

Acknowledgment is made for use of official photographs of the U.S. Army Air Forces.

(Continued on page 53)

Helping the flying box car bear its mighty burden



magnesium doors on the C-82 Packet "a great advantage"

It would have seemed impossible, just a few years ago—carrying trucks, heavy guns, even light tanks by air. Now it's routine for the huge Fairchild C-82 Packet . . . thanks to the ingenuity of design in the "flying box car."

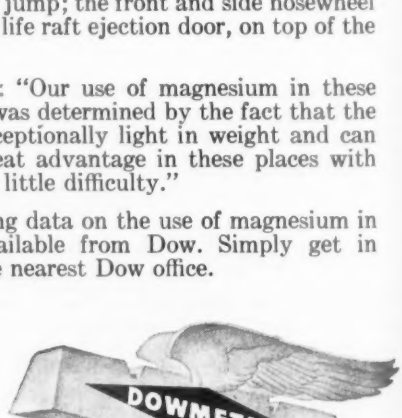
Magnesium alloys—with the highest strength-weight ratio of all common structural metals—have a very definite place in this accomplishment. To achieve maximum cargo capacity, the Packet carries a minimum of dead weight. That's why several of its doors, for example, are made of magnesium. Included are the paratainer door, through which paratroopers' equipment is parachuted as they jump; the front and side nosewheel doors; and the life raft ejection door, on top of the fuselage.

Fairchild says: "Our use of magnesium in these various parts was determined by the fact that the material is exceptionally light in weight and can be used to great advantage in these places with comparatively little difficulty."

Full engineering data on the use of magnesium in aircraft is available from Dow. Simply get in touch with the nearest Dow office.

MAGNESIUM

THE METAL OF MOTION



MAGNESIUM DIVISION, THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • St. Louis • Chicago • Houston • San Francisco • Los Angeles • Seattle

Some Design Considerations of Electrohydraulic Power Supply Systems

WALTER C. TRAUTMAN*

Bendix Aviation Corporation

Introduction

The past 3 years have seen the introduction and usage of a power transmission and control system in aircraft comprising both electric and hydraulic means. It is the purpose of this paper to relate the reasons motivating the choice of such a system, together with the design factors to be considered in the application of such systems to aircraft power-control problems.

Since the general description of electrohydraulic power-supply system can be construed to cover a number of systems, the following description will define the type of system with which this paper is concerned: "Electrohydraulic power-supply systems are those in which accessory power, from the aircraft's electrical generating system, is electrically transmitted through copper conductors to various parts of the aircraft and thence converted into mechanical force by hydraulic means."

Weight Limitations

No doubt the outstanding factor in the choice of any aircraft equipment is light weight, and this same factor is responsible, to a large degree, for the introduction of electrohydraulic systems in aircraft. This factor will therefore be the chief consideration insofar as this paper is concerned.

It is known that, where power transmission over reasonable distances is involved, an all-hydraulic system will entail the least weight. However, when the distance between the source of power and the point at which the power is applied increases, we find that the overall weight of a hydraulic system, expressed in terms of pounds per horsepower, increases rapidly.

Factors Causing Increased Weight

(1) Rapid increase of pump suction line size necessitated by the fact that the pressure difference between the reservoir and the pump inlet must remain reasonably constant regardless of the length of this line.

(2) A marked tendency on the part of airplane designers to design hydraulic transmission lines with high efficiencies approaching those of electrical systems.

(3) An inherently lower transmission line weight for electrical conductors compared to hydraulic transmission lines, particularly at the lower horsepower ratings.

The last two factors can readily be discerned from Fig. 1. Here the rather high weight of hydraulic transmission lines operating at −60°F. can be seen, particularly when operating at the higher efficiencies such as are common in electrical systems.

The weight ordinate includes for hydraulic lines: the tubing, typical number of fittings, and the hydraulic fluid. For electric lines this includes the conductor, terminals, terminal screws, terminal strips, and a typical allowance for junction boxes. The horsepower scale is based on mechanical horsepower transmitted and the efficiencies of electric and hydraulic motor devices are therefore included. These data pertain to a transmission line length of 50 ft.

Hydraulic Efficiencies

It is readily evident that if the designer attempts to maintain a fairly high efficiency in a hydraulic transmission line when transmitting power over fairly great distances he will suffer a severe weight penalty. Part of this can be overcome by slightly reducing the transmission efficiency, but the greatest saving can be effected by making use of the low weight of electrical conductors as power transmitting means.

The manner in which this is accomplished can best be seen in Fig. 2, which shows in phantom a typical large military aircraft. Herein are placed electrohydraulic power supplies to operate the following: (1) nose landing gear, (2) wheel brakes, (3) main landing gear, (4) bomb doors, (5) wing flaps.

In this installation a single power supply is used to operate the nose land-

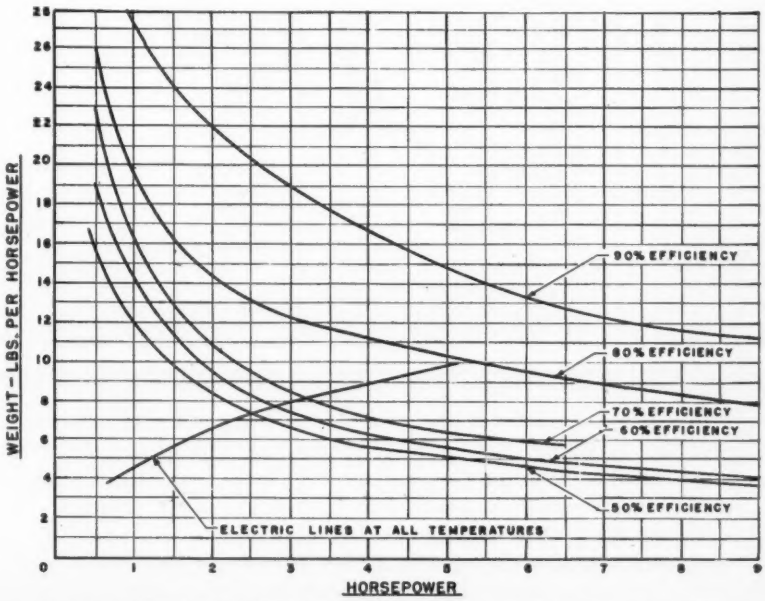


Fig. 1. Comparison of electric and hydraulic power transmission lines at −60°F.

Presented at the National Fall Meeting, I.A.S., Dayton, Ohio, November 9–10, 1944.

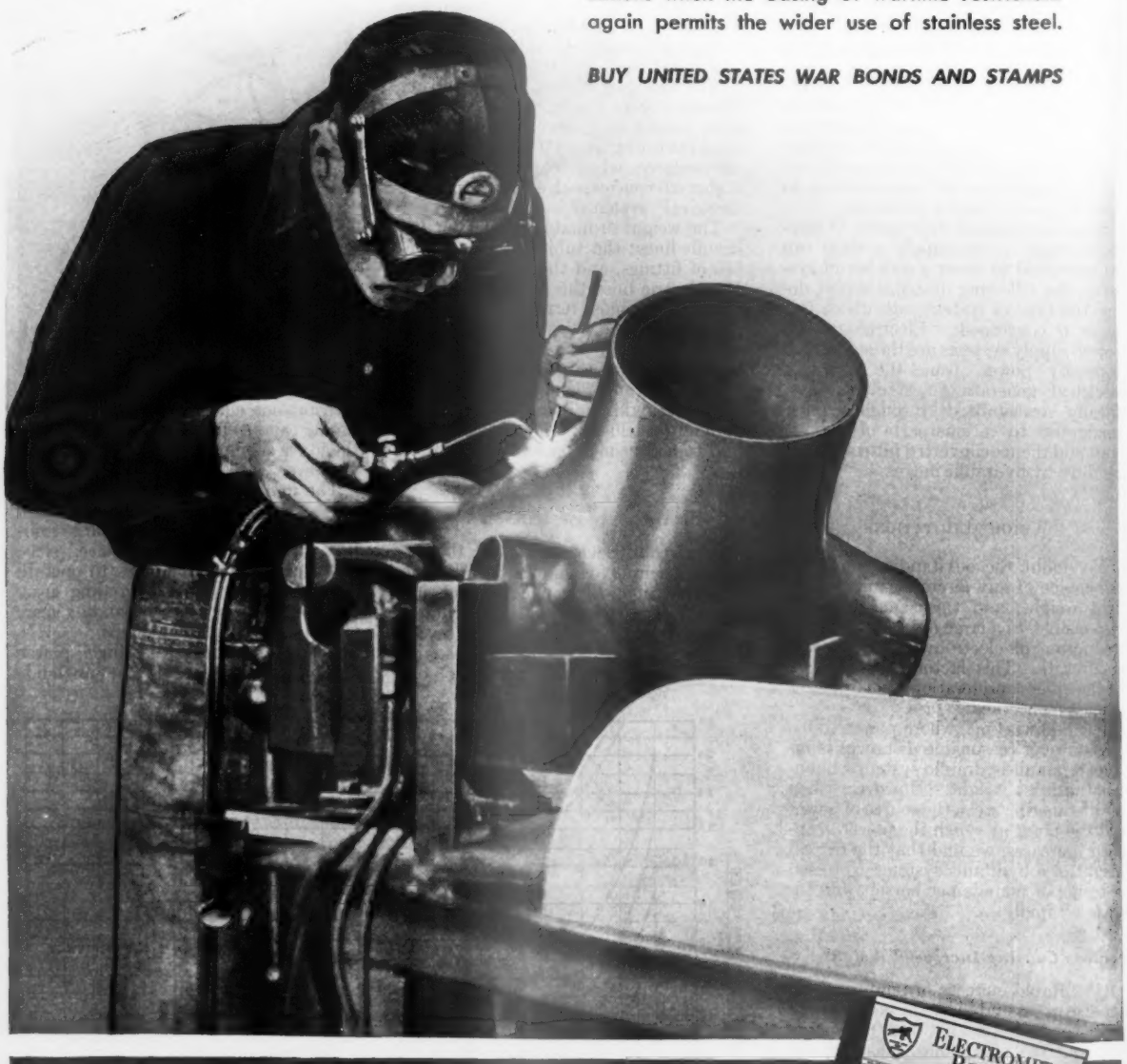
* Chief Hydraulic Engineer, Pacific Division.

Welded Exhaust Pipe for Thunderbirds

Stainless steel is essential in aircraft exhaust assemblies because it resists the corrosion of hot exhaust gases. With thousands of these assemblies being fabricated each month, the ease with which this metal can be welded is an important factor in maintaining production.

Because of their corrosion resistance and strength, stainless steel aircraft parts can be made of relatively thin gauge metal. These properties will be valuable for many other industrial applications when the easing of wartime restrictions again permits the wider use of stainless steel.

BUY UNITED STATES WAR BONDS AND STAMPS



Other interesting uses of stainless steel are described in ELECTROMET REVIEW published by ELECTRO METALLURGICAL COMPANY, the Unit of UNION CARBIDE and CARBON CORPORATION that produces alloys for making steel. If you are an executive, engineer, or designer you can be put on the mailing list for ELECTROMET REVIEW by sending your name on your business letterhead to ELECTRO METALLURGICAL COMPANY, Room 328, 30 East 42nd Street, New York 17, N. Y.

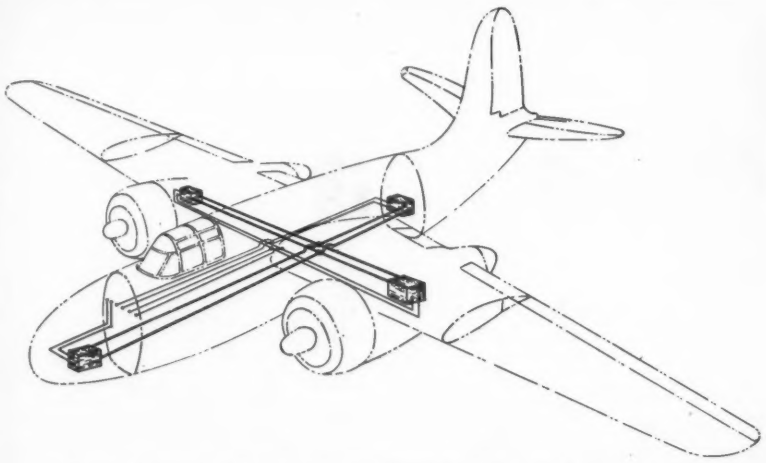


Fig. 2. Placement of electrohydraulic power supplies in multiengined aircraft.

ing gear and wheel brakes, while a similar unit operates the bomb doors and wing flaps. The functions related are only typical and for illustrative purposes.

Equipment Location

The moving of bulky controls and equipment from the center of the fuselage, outward to those remote points where power is desired brings about a further advantage, in that equipment congestion in the cockpit and center fuselage area is relieved. This equipment is placed in the nose section and nacelles where more adequate space is generally available. Accessibility of this equipment for service purposes is further enhanced by this relocation.

The elimination of equipment congestion in the fuselage, together with the fact that equipment that may leak or drip on baggage is no longer in the fuselage, is an important consideration in commercial transport aircraft.

Types of Systems

Since there are already some electrohydraulic systems in service and more are contemplated, a clarification and explanation of the various types will be made.

The first and earliest type of system in use consists of an electric motor-driven hydraulic pump supplying hydraulic pressure to a small isolated hydraulic system, such as for power brakes, nose-wheel steering, or gun-turret operation. Here the function is of the simplest nature, and control is only limited to the maintenance of pressure.

A variation of this type of system employing more complex control is that found driving the ball-type turret in certain bombers. In this type an electric motor drives two variable volume pumps at either end, and these in turn drive hydraulic motors. This device is shown in Fig. 3. The direction and speed of rotation of the hydraulic motor at each end are easily controlled through a small control shaft. Although the control is of a fairly complex nature, it is interesting to note that the complete wet weight of a 2-hp. unit is 58.25 lbs., whereas a similar all-electric drive developing but 0.50 hp. weighs 117 lbs. Since these devices are usually located in remote spots, the weight of each electrical transmission system is the same and the weights noted are directly comparable.

The second type of system comprises an electric-motor driven hydraulic pump supplying fluid to a complex hydraulic system in which sequencing and synchronizing functions of the various elements are accomplished by hydraulic means. Such a system usually contains an electrohydraulic power supply —i.e., electric-motor driven hydraulic pump, reservoir, filters, system check and relief valves, and control valves, located in close proximity to the hydraulic cylinders it is to operate.

A typical power supply of this type can be seen in Fig. 4. The reservoir filler neck and electrical power receptacle are visible in this view. Fig. 5 shows the opposite end of this same power supply, disclosing the hydraulic quick-disconnect couplings that lead to the various operating cylinders.

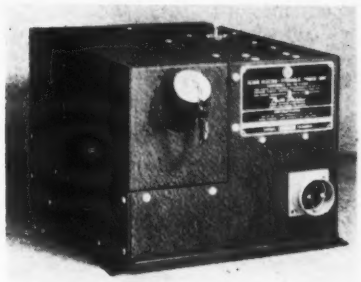


Fig. 4. Electrohydraulic power supply—electrical end.

Fig. 5. Electrohydraulic power supply—hydraulic end.

The third type of system uses a reversible electric-motor driven hydraulic pump supplying fluid to a complex hydraulic system in which the sequencing operations are electrically performed. The fundamental reversal of the operating cycle is obtained by reversing the rotation of the motor pump. This is easily achieved by a simple valve mechanism and thereby effects reversal of control at a minimum of weight expense.

The sequencing of a multiplicity of operating cylinders is accomplished by a small electric-motor driven selector

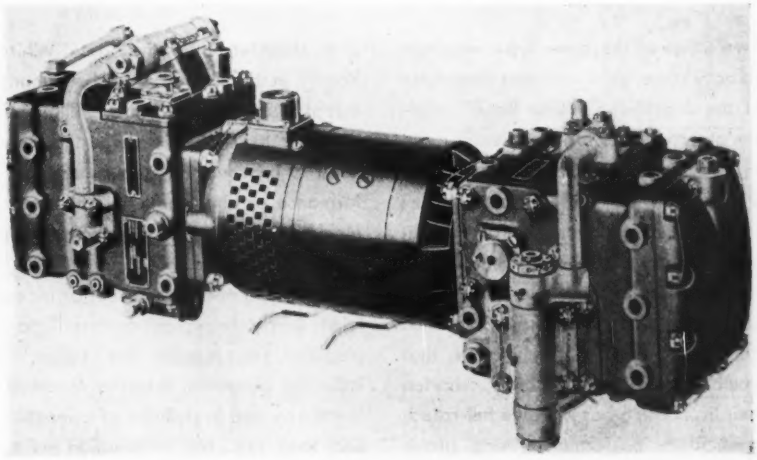
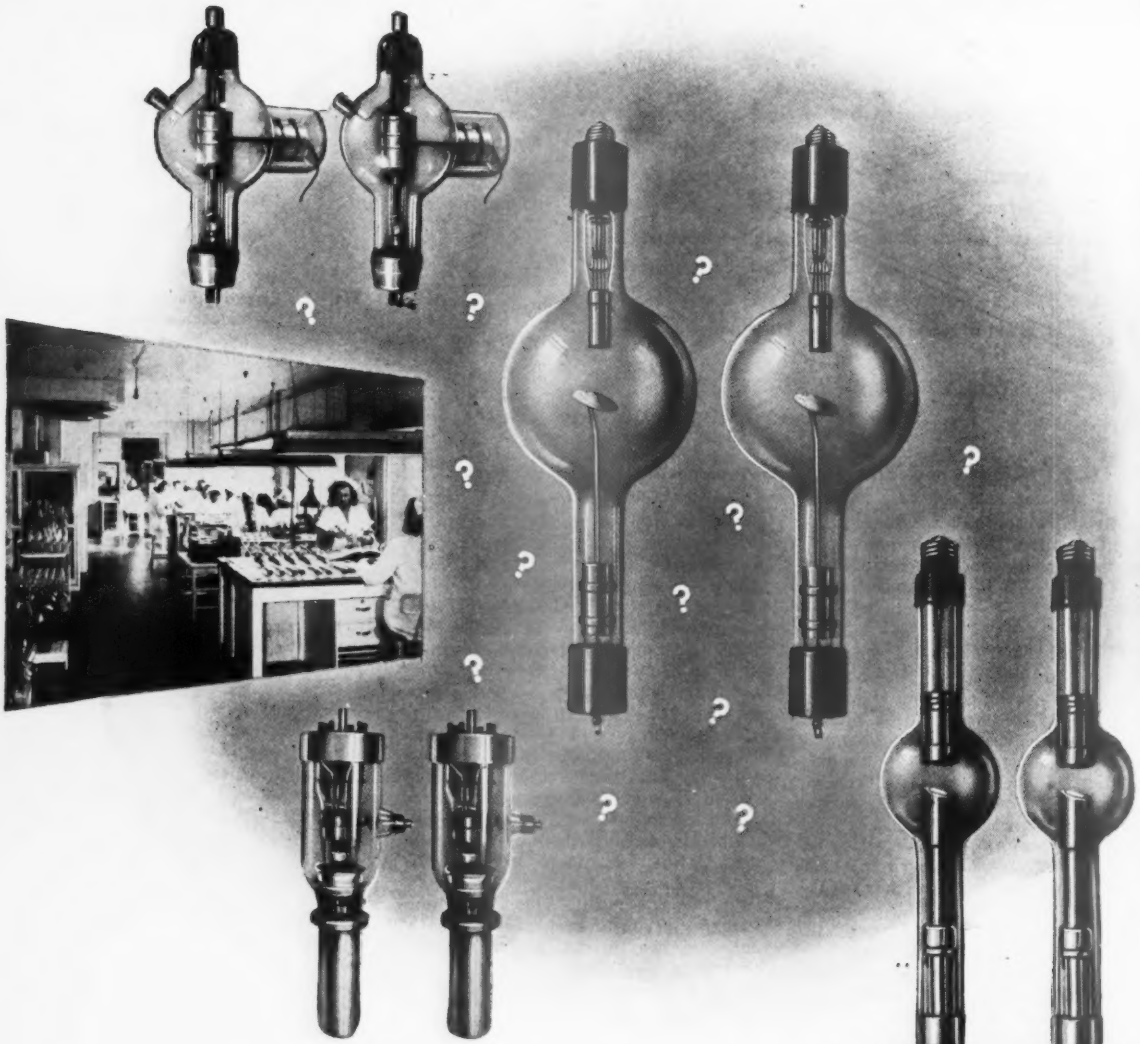


Fig. 3. Electrohydraulic gun-turret drive.



CAN YOU TELL WHICH TUBES ARE BETTER?

Two tubes of the same type may look exactly alike, but if one was assembled in the Machlett "White Room" while the other was put together under average factory conditions, there would be a considerable difference between them. In lighting, cleanliness and conditioned environment, the "White Room" resembles a hospital operating room, and tubes passing through it remain free of internal contamination that would lessen their stability, shorten their life. Such tubes will give full-rated, predictable performance, and prove uniformly economical and satisfactory. It was to achieve such improved results that Machlett built the first "White Room" in the industry — subsequently adopted by others. Many still newer Machlett techniques, such as this, continue to improve the quality and performance of our products. In this way, Machlett leadership in the electron tube field is maintained.

When you need a medical or industrial X-ray tube, or an oscillator, amplifier, or rectifier for radio or industrial purposes, select a Machlett. It will pay you in stability of operation and long life. For information as to available tubes, write Machlett Laboratories, Inc., Springdale, Connecticut.

EG-50—an X-ray tube with beryllium window for radiography of light materials and thin sections.

MACHLETT

X-RAY TUBES SINCE 1897

TODAY THEIR LARGEST MAKER

valve designed for the application on hand, and driven to its proper position by small limit switches associated with, and actuated by, the various operating cylinders.

This system is by far the best, insofar as weight-saving is concerned, in that further weight reductions are induced by the following:

(1) Lowest possible weight of sequencing valve mechanism due to its concentration in one housing.

(2) Elimination of oil-filled hydraulic lines to and from the conventional sequence valve installations, and replacement with light electric control wires. Attention is drawn to the fact that in conventional hydraulic sequence valve installations the full flow is required in all parts of the circuit, thereby requiring large line sizes. In electrical sequencing only a small control current passes through the sequencing switches.

(3) Reversal of the sequencing cycle can be accomplished with a minimum of additional weight as function in two directions becomes a simple valving matter with no addition of electric controls.

Systems of this type are not in service as yet, but are under development. It is expected that much of future development will follow along the path of this system.

Combined System

The fourth and last type of system is an elaboration of the type just described, and comprises all of the elements of this latter system except that it is used to operate two separate systems not simultaneously.

For example, an electrohydraulic power supply may be mounted in the middle of the fuselage for operation of both wing flaps and bomb doors. This is accomplished by selectively determining, in the cockpit, which of two separate operating systems the electric-motor driven hydraulic pump will operate.

Electrical sequencing, or positioning, can be accomplished in either operating system without interfering with the other. Obviously these systems cannot be simultaneously operated, but this need not be a hindrance if the proper combination is used, since there are functions on aircraft that need not be performed simultaneously.

The weight of the electric motor, hydraulic pump, and reversing mechanism is then amortized over two systems instead of one, making this system extremely attractive from the weight standpoint. Obviously, if a third system could be operated from this same source of power, its value would be further enhanced.

Another combination of systems which works out well is found in combining the nose-wheel operating system with the power-brake supply system. Such a system has been designed in which the brake-accumulator is kept charged between certain pressure limits automatically and at all times except when the nose wheel is either extending or retracting. Since this short interruption of accumulator charging is not serious, an attractive weight-saving can be effected with a minimum number of components.

Weight-Saving

A comparison between the weight of an electrical system for actuating the nose landing gear and doors of an all-electric airplane, added to the electrohydraulic system necessary for wheel-brake operation, and the weight of an electrohydraulic power supply to perform both of these functions on the same aircraft, reveals that the latter system effects a weight-saving of 93.40 lbs., or 18.5 per cent of the former system. It is anticipated that this arrangement of using one electrohydraulic power supply to provide power for both nose-wheel retraction and the power-brake system will find considerable usage in multiengined aircraft.

While this particular combination is cited only as an example, it follows that there are other combinations (particular to a given aircraft) to which such a system can be applied.

It is fortunate that sufficient work on electrohydraulic power supplies has been done to date to yield data as to the weight of such units. This weight is shown in Fig. 6 as a function of the hydraulic horsepower output of the device. The range covered is from 0.75 to 5.0 hp., and therefore covers the majority of sizes likely to be in use for some time. Because of the straight-line characteristic of this empirically derived graph, it is apparent that it can be used with fair accuracy in predicting weights for new designs.

It should be remembered that the weight shown includes a complete hydraulic power system, electrically driven and controlled, and includes the reservoir, filters, pressure-relief valves, check valves, pressure switches, electrical and hydraulic disconnect fittings, and power relays. It is expected that as the development of the equipment noted progresses, the weights shown may eventually be reduced by as much as 25 per cent. This will be particularly true if the individual items comprising power-supply units are designed especially for the purpose rather than using existing equipment.

The weight values shown in Fig. 6 are for power supplies capable of complex functions, and these values are therefore high for power supplies performing but singular functions. Of greater interest is Fig. 7, which shows the percentage of weight-saving afforded by electrohydraulic systems compared to electromechanical systems at various output horsepower ratings.

This comparison was based on the weights of completely installed systems (exclusive of the electrical power transmission lines) of each type. In each case both systems were specifically designed for the same application, and each application involved a complex function such as the sequencing of three different functions. Sufficient data were available throughout the horsepower range shown to yield a fairly regular curve, and, although extrapolation of the curve at either end may yield doubtful results, the slope of the curve itself is indicative.

Although the weight of electrical transmission lines was omitted from this comparison, because it would normally be assumed to be the same in either case, this is not exactly true. This is occasioned by the fact that the comparison was made on the basis of output horsepower. The electrical input horsepower of the electromechanical system will be higher than that of the electrohydraulic system at the same output power because of the lesser conversion efficiency of the electromechanical system. Thus, the electromechanical system will draw more electrical power, and the weight of its transmission line will be somewhat greater than that required by the equivalent electrohydraulic system.

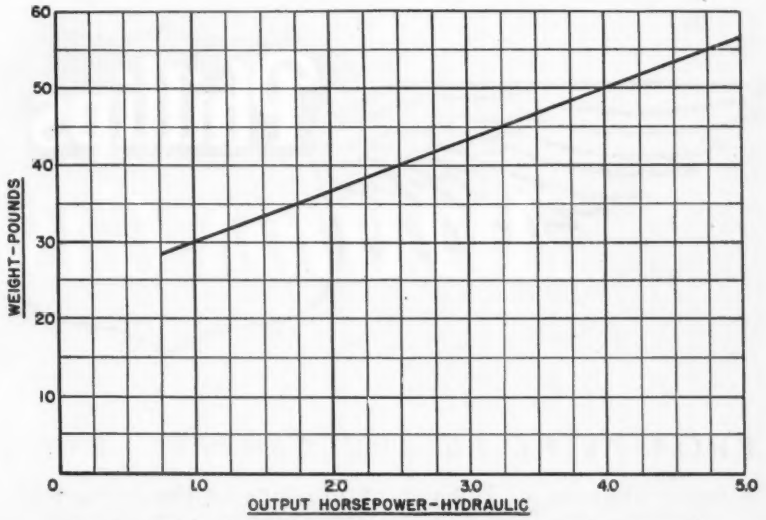


Fig. 6. Weight of electrohydraulic power supplies at various horsepowers.

Phillips laboratories, on ground and in air, have made great contributions to the improvement of 100-octane Aviation Gasoline

Phillips
AVIATION GASOLINE

PHILLIPS PETROLEUM COMPANY, BARTLESVILLE, OKLAHOMA

A major supplier of 100 octane gasoline to the Army, Navy, and United Nations air forces

In
orde
grea
an
follo
obse
(1
dista
poin
ticul
zero
ated
(2
poin
This
the
units
by
units
(3)
form
opera
ing t
of th
and
sible.
(4)
an ac
contr
comp
of th
pump
circui
(5)
forme
switc
select
tion
revers
motor
a rev

Conclusions

In summation, it may be said that in order for the designer to effect the greatest weight-saving in the use of an electrohydraulic system the following points should be carefully observed.

(1) Use this system where fairly great distances between the power source and point of power application exist, particularly when sluggish operation at sub-zero temperatures cannot be tolerated.

(2) Install power units as close to the point of power application as possible. This not only makes for more room in the fuselage but puts the power units in more accessible locations, thereby facilitating service of these units.

(3) Use the same power supply to perform more than one function, such as operating the nose landing gear, supplying the brake pressure, etc. This is one of the most important considerations and should be utilized wherever possible.

(4) Where only a simple reversal of an actuating cylinder is required as the control function, this can be best accomplished by reversing the rotation of the electric motor and hydraulic pump, and using a reversible hydraulic circuit.

(5) Sequence operations to be performed electrically by means of small switches operating an electrically driven selector valve. This sequence operation can also be made reversible by reversing the rotation of the electric-motor driven hydraulic pump and using a reversible hydraulic circuit.

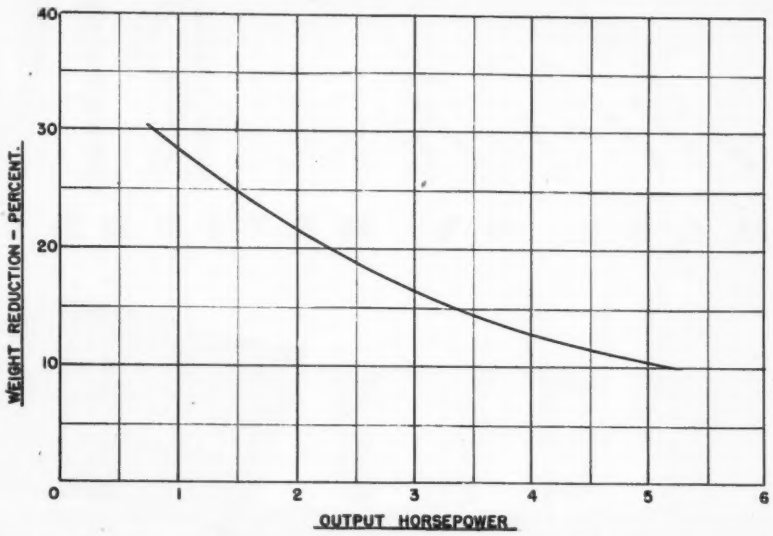


Fig. 7. Percentage of weight reduction effected by electrohydraulic system compared to electromechanical system.

(6) Place all the control valves in the power-supply unit (such as check valves, relief valves, selector valves, etc.) in a common valve housing, thereby utilizing internal porting to eliminate tubing and heavy tube fitting assemblies.

(7) See that power-supply units are completely self-contained and capable of being removed from the aircraft by disconnection of the electrical and hydraulic disconnect fittings. This allows the complete unit to be bench-tested after servicing without the use of large and costly test benches. Replacement of power-supply units on aircraft in service can then be accomplished in a matter of a few minutes.

The use of electrohydraulic power-supply systems in aircraft offers the designer a new way of saving weight in accessory operating equipment. This weight-saving can be a direct function of how well the designer integrates the details of such a system into the particular requirements to be met. A close study of the numerous advantages that such a system offers, correlated with a similar study of the details of the problem, will yield much toward realizing the advantages outlined in this paper.

Library Facilities *of the*

Institute of the Aeronautical Sciences

To serve Institute members and others in the aeronautical industry, the Institute of the Aeronautical Sciences offers the facilities of:

The W. A. M. Burden Library
1505 RCA Building West
30 Rockefeller Plaza
New York, N. Y.

The facilities of this library are available for reference study at the offices of the Institute.

The Paul Kollsman Library
1505 RCA Building West
30 Rockefeller Plaza
New York, N. Y.

This library loans books without charge to members and others in the United States over eighteen years of age. Full information will be sent on request.

The Pacific Aeronautical Library
6715 Hollywood Boulevard
Hollywood, Calif.

This is a service and reference library for West Coast organizations. Full information as to its facilities will be sent on request.

hi-shear RIVETS

TRADE MARK

MADE BY NATIONAL SCREW

The "Hi-Shear" Rivet consists of a specially formed, heat-treated alloy steel stud with a head on one end and a groove at the other end in which an aluminum collar is engaged by deforming. The riveting tool forms the aluminum collar into a high button head and shears off any excess metal.

When it is desired to repair or take apart any parts fastened with "Hi-Shear" Rivets, it is very easy to destroy the collar and push the rivet out of place without damaging the assembly.

The new "Hi-Shear" Rivet, adopted by several leading aircraft manufacturers, has a shear strength of 75,000 p.s.i. or three times that of the standard aluminum rivet.

When used to replace bolts and nuts, "Hi-Shears" effect a considerable saving of weight in the structure. This method also has an application advantage over that of applying a bolt and nut and then locking the nut by some means.

We manufacture and sell "Hi-Shear" Rivets in a full range of sizes (NAS Standards) under U.S. Patents 2,355,579 and 2,355,580 dated August 8, 1944 and Design Patent 138,579 dated August 22, 1944. Please send us your inquiries.

A D M A

National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

Aircraft Electrical Equipment

T. B. HOLLIDAY*

Wright Field

Introduction

For the purpose of this paper, the airplane can be divided into three parts: air frame, power plant, and accessories. The last named, aircraft accessories, includes all of the electrical equipment. Since there is such a great number of accessories, this field requires more varied engineering skill than either of the others.

In most airplanes the accessories are not essential to flight. They provide the luxuries and contribute to greater performance, ease of flying, or added safety. As experience proves that accessories are reliable, they can be expected to assume more important responsibilities.

This paper presents some of the background of development for aircraft electrical accessories and a discussion as to possible uses.

Description

The electrical system consists of three parts: the generator, the distribution wiring, and the loads. The generator is driven by a prime mover, either the main or auxiliary power plants, and it converts mechanical energy to electrical energy. The electrical power is distributed through insulated cables controlled by switching devices and protected by circuit breakers or fuses. The loads consist of more than 100 different items, which may be divided into the following categories: motors, radio, lighting, heaters, solenoids, and controls.

Presented at the National Fall Meeting, I.A.S., Dayton, Ohio, November 9–10, 1944.

* Colonel. Electrical Branch, Equipment Laboratory, Engineering Division, Air Technical Service Command.

Choice of Voltage

The volt is the measure of electrical pressure. As the generator, Fig. 1, is rotated by the prime mover, voltage is developed at the generator terminals in accordance with the equation

$$E_g = KZN\varphi \times 10^{-8}$$

where

E_g = voltage generated
Z = number of conductors connected in series
N = speed in revolutions per sec.
φ = flux in magnetic lines of force

Since the total flux, φ, is directly proportional to the current in field windings

$$\varphi \propto I_f$$

and

$$E_g \propto ZNI_f$$

The generated voltage is dependent on two variables—speed and field current. Since at any time of operation the speed is fixed by the prime mover, the control of voltage is accomplished by varying I_f, the current in field coils.

This briefly describes the process of voltage generation, but a generator can be designed to produce practically any voltage from a fraction of one to several thousand. This is done during the design stage by varying Z, the number of conductors, and φ, the amount of flux.

In the past, the voltage of aircraft electrical systems has been fixed by the battery. The battery is the familiar lead acid type, and the aircraft unit is similar to the automotive unit. The generator and battery act together to supply loads and are connected as shown in Fig. 2. The generator is the pump and the battery is the reservoir of the electrical system. Each cell of the battery will deliver power at 2 volts. However, during restoration of electrical energy, termed "charging," an impressed voltage of 2.25 is needed.

The battery in an automobile has three cells and a rated voltage of 6. A charging voltage of 6.75 is needed, and, since some margin is provided in generator ratings, the latter can deliver 8 volts. Thus, the automotive electrical system can be described as the 6–8-volt system.

Prior to 1939 military aircraft used a 12–15-volt system; today they use a 24–30-volt system. The need for a still higher voltage is at hand. Higher operating voltages are most advantageous in reducing the weight of the wiring. The wiring weight is approximately inversely proportional to the square of the system voltage. For transmission of a given amount of power, the size of conductor will depend on (1) thermal limits of the conductor and (2) tolerable voltage loss in the conductor.

$$P = EI$$

where P = power in watts, E = voltage, and I = current in amperes. The size of a conductor is directly proportional

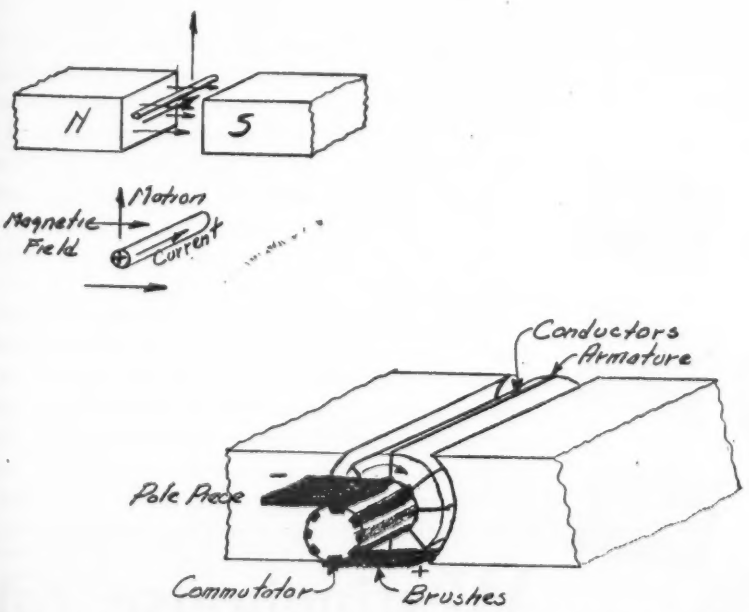
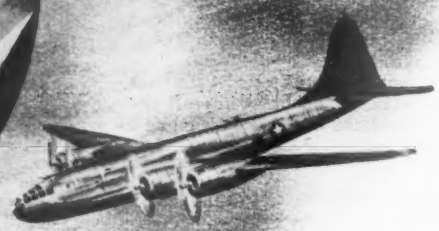


Fig. 1. In the generator, motion of conductors across a magnetic field causes movement of electrons and, therefore, current in the direction indicated. The function of the commutator is to reverse conductors as they move from one pole to the next and opposite pole. Only two poles are shown. Any even number can be used. Four and six are popular for aviation equipment.

HIGH ALTITUDE TEST CHAMBER GIVES "THIRD DEGREE" TO AIRCRAFT MOTORS AT 67° F. BELOW ZERO



In the stratosphere—as high as 50,000 feet—aircraft motors must withstand extremes of temperature, atmospheric pressure, humidity. These unearthly conditions required development of aircraft motors that gave dependable performance . . . from "take-off" in tropical jungle heat . . . to "ceiling" flying in sub-zero, rarefied air.

Westinghouse Aircraft Motors have been designed and built to meet these severe requirements. Westinghouse research engineers check and analyze the performance of motors, brushes and commutators in a high altitude chamber which duplicates conditions at 50,000 feet. Temperature is lowered to minus 67° F. to check starting conditions . . . atmospheric pressures of 1/7 sea-level pressure show the motors' performance when starved for ventilation.

Aircraft requirements of light, durable, compact, rugged construction . . . are met in Westinghouse Aircraft Motors. Their dependable performance has been proved on many types of planes—from the largest bombers to the smallest fighters. For complete information on Westinghouse Aircraft Motors call your nearest Westinghouse office. Or, write Westinghouse Electric & Manufacturing Company, Lima, Ohio.

J-03222

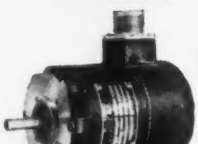
WIDE RANGE OF WESTINGHOUSE *LONGER LIFE* AIRCRAFT MOTORS

Westinghouse pioneered in the development of aircraft motors . . . in research, design, engineering. Using the finest materials and manufacturing methods, Westinghouse Aircraft Motors have kept pace with aeronautical progress. They are light in weight and small in proportion to their ratings. A wide variety of sizes and ratings are available to meet individual requirements.

This open-type, self-ventilated motor, with 2⅝" frame, provides 1/50 hp at 4800 rpm.

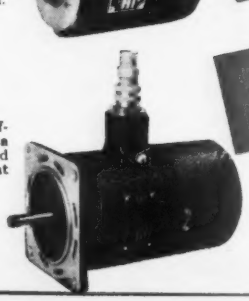
1/50 HP

This aircraft motor is rated at 1/6 hp continuously at 5800 rpm.



1/6 HP

This open-type, self-ventilated motor has a 4" frame and is rated 1 hp continuously at 7500 rpm.



1 HP

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

AIRCRAFT MOTORS

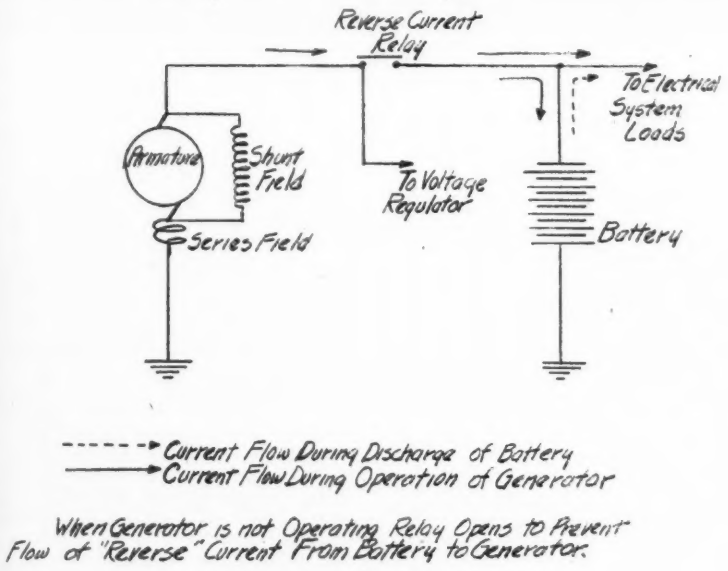

Reverse Current Relay
To Electrical System Loads
Armature
Shunt Field
To Voltage Regulator
Series Field
Battery
Current Flow During Discharge of Battery
Current Flow During Operation of Generator
When Generator is not Operating Relay Opens to Prevent Flow of "Reverse" Current From Battery to Generator.

Fig. 2. Generator and battery diagram.

to the amount of current that must be carried therein. If voltage is doubled, current and conductor size is halved.

Losses

The conductor has resistance that causes thermal losses. Some of the impressed voltage and power is lost in forcing current through this resistance. The tolerable loss for continuous duty circuits is 3 per cent.

$$e = Ir \leq 0.03E$$

where e = line loss in volts and r = resistance of line in ohms. When E is doubled, the tolerable loss in the line is doubled and conductor size can be halved again. Therefore, doubling voltage permits use of a conductor having one-fourth weight.

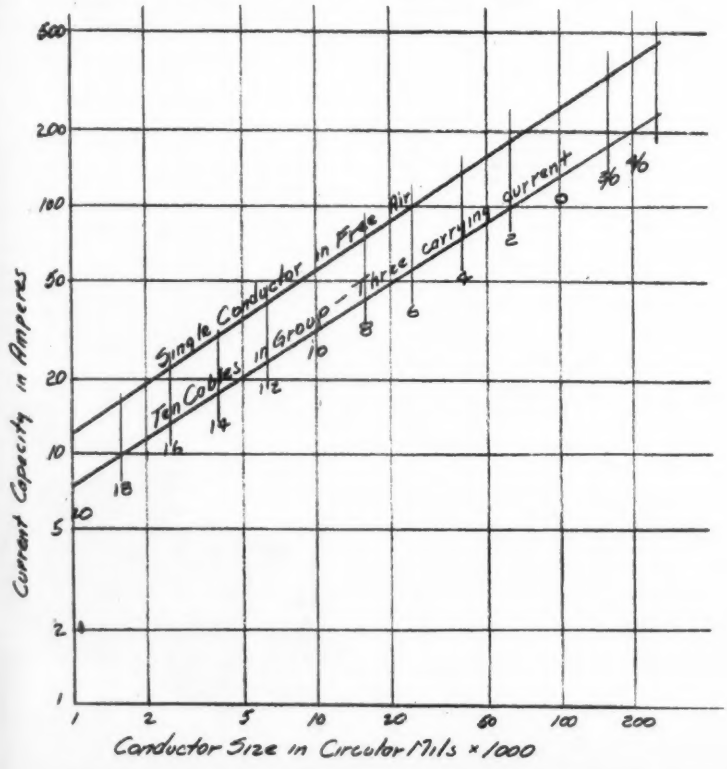


Fig. 3. Approximate current ratings at conductors per Spec. AN-J-C-48.

A second limit is reached when the conductor may overheat.

$$P = EI$$

then line loss

$$p = eI = I^2r$$

This power appears as heat and raises the temperature of the conductor. Most wiring can withstand operation at 150°C. Special types of insulation can withstand higher temperatures. The abilities to carry current of various sizes of a given conductor are shown in Fig. 3. The distance these sizes will carry this current at a loss in voltage of 1 volt is shown in Fig. 4.

The theoretic weight of conductor to deliver power at various voltages at a distance of 100 ft. is shown by the chart in Fig. 5. This plainly shows the weight handicap that the automotive electrical system would impose on a reasonably large aircraft. At voltages up to 50, the primary consideration is voltage regulation and not thermal limits of wire.

Power Supply Equipment

The source of electrical power is the generator. In practically all cases one generator is mounted on each engine. In multiengined aircraft the total available electrical capacity should be such that the electrical needs can be met with the minimum number of engines that can sustain flight. In addition, some margin should be left for growth of the electrical system. In single-engined aircraft the generating capacity should exceed the maximum load by 25–50 per cent to allow for this same growth.

This growth factor is not an imaginary requirement. Probably the worst possible combination of circumstances surround the history of the B-17 (Flying Fortress) airplane. The original version had 2.25 kw. of generator capacity. The B-17G has 24 kw., and preparations are completed for installing 36 kw. in certain special airplanes. The British version of the B-24 (Liberator) had 6 kw.; today special units require 36 kw. The original P-38 (Lightning) had 1.5 kw.; today's version has 6 kw.

If a four-engined airplane can fly with two engines, it must be able to fight with two generators.

Space Requirements

For practically the entire era of aviation the generator has been restricted to a space $6\frac{1}{2}$ in. in diameter on the accessory section of the engine. As a result, the electrical industry has been forced to meet expanding electrical needs without any increase in allowable space. In 5 years the output of generators has been increased to 16 times its original value. Weight has increased from 34 to 48 lbs. Specific weight in pounds per kilowatt has reduced from 44 to 4.

A typical generator that has resulted from this development is shown in Fig. 6. It has been necessary to utilize

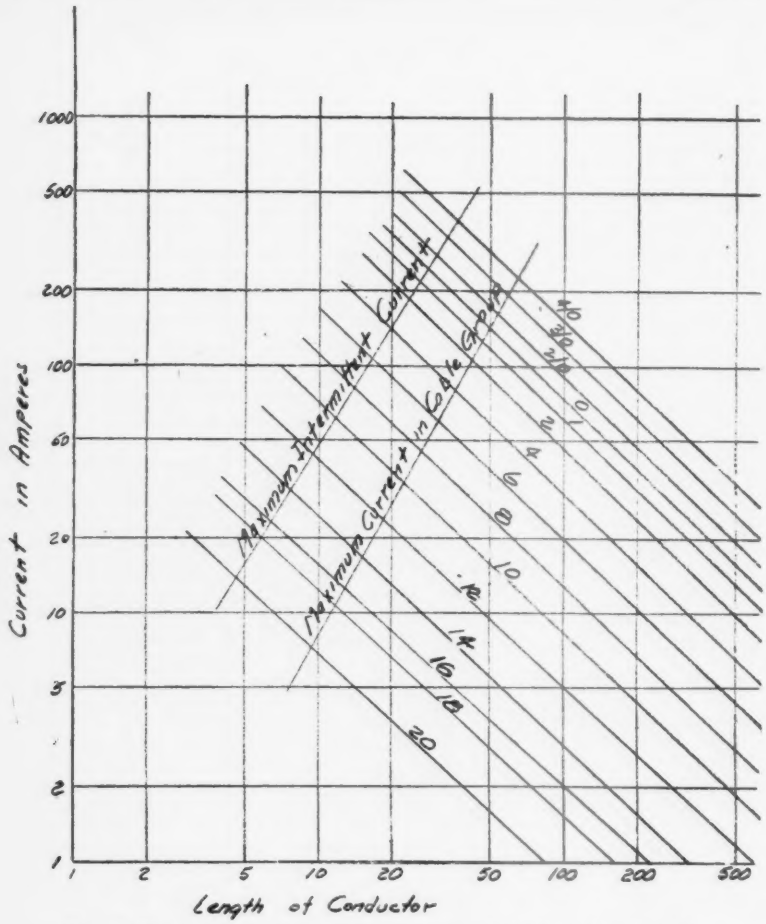


Fig. 4. Distance that conductors will carry current with voltage loss of 1 volt.

blast-cooling of this machine for two reasons: (1) Fans lose effectiveness at altitude; (2) the temperature in engine nacelles is high and the tendency is toward still higher limits.

Cooling

Machines to and including 9-kw. ratings have a 2-in. blast tube. The generator is designed on the basis that there will be a differential air pressure of 6 in. H_2O across the machine. To obtain this pressure the aircraft manufacturer must carefully consider the installation of the blast tube. It is only natural to choose a point of inlet that causes a minimum aerodynamic drag. Since the requirement for air is comparatively small, the tube inlet is usually located with some other cooling duct.

There is usually adequate pressure available, even at the minimum operating speeds of the airplane. However, adequate pressure does not appear at the generator because (1) the duct is long or crooked or a poor material is used and (2) considerable back pressure exists in the nacelle. It is hard to understand how engineers who are experts in the theory and practice of airflow can design such ineffective ducts for generator cooling. Fig. 7 illustrates one that is long and inefficient.

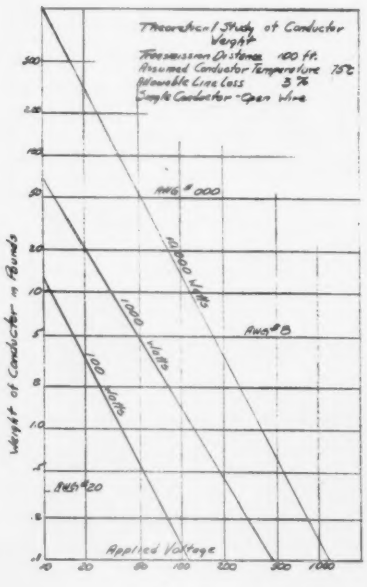


Fig. 5.

Mechanical Problems

Two serious mechanical problems have been experienced with generators. They are both due to vibration—torsional and linear. Some generator designers have chosen a quill shaft to absorb torsional vibration. Fortunately, most of these have avoided operation at critical frequencies, but one did not. As a result, it is now necessary to require some type of frictional damper as well as a quill shaft.

Linear vibration can cause structural failure at either end frame of the generator. All of the failures at the commutator rear end were caught in time, but troubles occurring between the mounting flange and magnetic field frame have been altogether too frequent. Some of this has been traced to improper installations of mounting stud nuts. The remainder has caused frantic development of the mounting flange and attachment bolts. It has resulted in the following steps with one or more generator manufacturers:

(1) Discarding magnesium as a material.

(2) Using aluminum only when the generator weighs less than 35 lbs.

(3) Requiring high-quality steel heads for most generators.

(4) Using 16–24 attaching bolts between the generator frame and mounting head.

(5) Developing a bayonet locking ring that will support the generator continuously and will permit separate and easy attachment.

To summarize this situation, neither engine nor aircraft manufacturers have presented adequate information on which the electrical engineer can base a design.

Voltage Regulation

The generator is controlled by a voltage regulator, a typical example being shown in Fig. 8. The function of this regulator is to adjust the field current, and therefore magnetic flux, to maintain constant voltage under conditions of varying speed and load. Some of the characteristics of generators are shown in Fig. 9. These illustrate the behavior of the generator output with

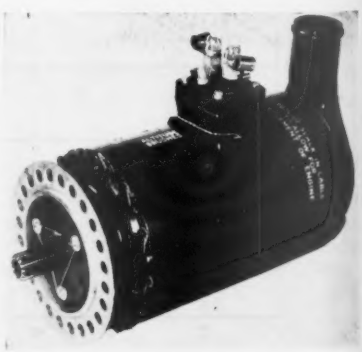
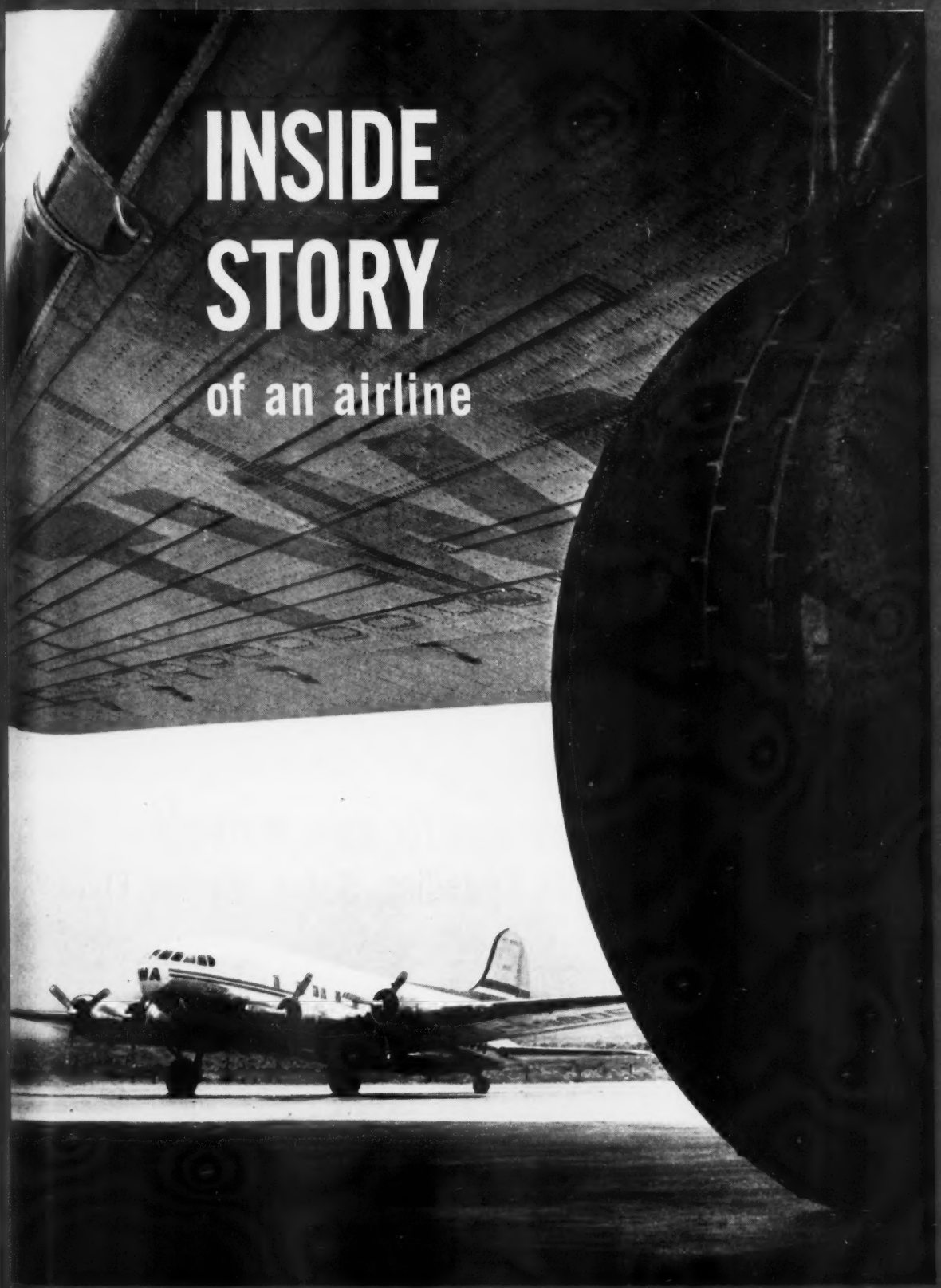


Fig. 6. Six-kw., 30-volt d.c. generator for aircraft.



Serving Through Science

UNITED STATES RUBBER COMPANY

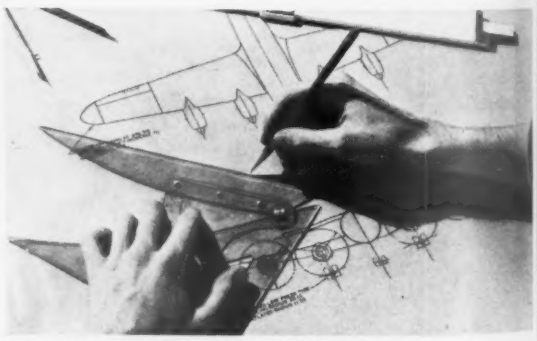
1230 SIXTH AVENUE · ROCKEFELLER CENTER · NEW YORK 20, N. Y.

How T.W.A. "Points the Way" to

Science Searches for New Methods— New Materials for Speedier, Safer, Better Flying

Pointing the way to broader horizons for air transportation, T.W.A. scientists are constantly at work behind the scenes. They check and regulate the most delicate mechanism. They find ways to improve and make even more efficient the latest in aviation equipment. It is their job, too, to discover new refinements to make present T.W.A. airliners better and to speed the way to the greater, more luxurious airliners of the future.

An example of the search of science for a higher level of efficiency is the work of William Enbrecht, T.W.A. master mechanic. Here he examines an altimeter in T.W.A.'s instrument shop in Kansas City. The work of scores of skilled T.W.A. technicians points the way to finer air transportation. It is the "inside story" of a great airline.



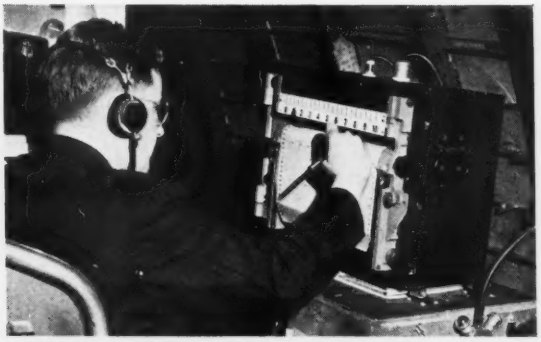
DRAWING BOARD BIRTH OF AN AIRPLANE—Working in closest cooperation with airplane manufacturers, T.W.A. draftsmen lay out the basic concept of a four-engined transport.

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon, 3:00 to 4:30 E.W.T.

UNITED STATES

to Finer Air Transportation

PLANNERS—To the last detail of convenience and efficiency, T.W.A. planners Joseph Hawkins and Glenn Scott draft plans for efficient buffet design.



TESTERS—Aerodynamist George C. Prill takes readings on a recording thermometer—checking cylinder head and air temperatures.

COMFORT ENGINEERS—To assure the utmost in passenger comfort, T.W.A. engineers Luther Hoffman and E. J. Mills work out a seating arrangement in a cabin mock-up.

TEST PILOTS—Every new addition to a T.W.A. airliner is flight-tested—contributing to the safety and dependability of today's air service. Here, Engineering Pilot Jack B. LeClaire takes a plane aloft for test.

LIGHTING PROJECT...Before—An example of T.W.A. progress toward perfection is this lighting project. Here lighting on the instruments causes glare—interferes with the pilot's night vision of outside objects.

LIGHTING PROJECT...After—T.W.A. engineers developed "black light" now used throughout the T.W.A. fleet. Dials and pointers are clearly illuminated, glare is eliminated and night flying visibility improved.

RUBBER COMPANY 1230 SIXTH AVENUE
ROCKEFELLER CENTER • NEW YORK 20, N. Y.

T.W.A. AIRLINERS OF THE FUTURE ARE FLYING *Today!*

T.W.A. Stratoliners are flying again! Inaugurated at LaGuardia Airport, N. Y. on April 1, 1945, these new giant four-engined Boeing planes are giving American air travelers today a foretaste of air travel of the future. Another example of coordinated engineering skill, the T.W.A. Stratoliner Fleet points the way to finer air transportation.

...and U. S. ROYAL AIRPLANE TIRES OF TOMORROW

are Ready Now!

Ready now, for the airliners of tomorrow are lighter, stronger U.S. Royal Airplane Tires. With bodies of rayon—pioneered by "U.S." for the aviation industry—and with tough, smooth landing, long-wearing treads, these U.S. Royal Airplane Tires are products of science.

"U.S." scientists and technicians, digging deep into the specific needs of air transportation, have "pointed the way" to happier landings—and more landings—even under the grueling conditions of wartime operations at home and on world battle-fronts. From the constant search for new and better ways to build new and better tires has come the U.S. Royal Airplane Tire—ready today for the airplane of tomorrow.

The "inside story" of U.S. Royal Airplane Tires, too, is the story of serving through science.

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue · Rockefeller Center · New York 20, N. Y.

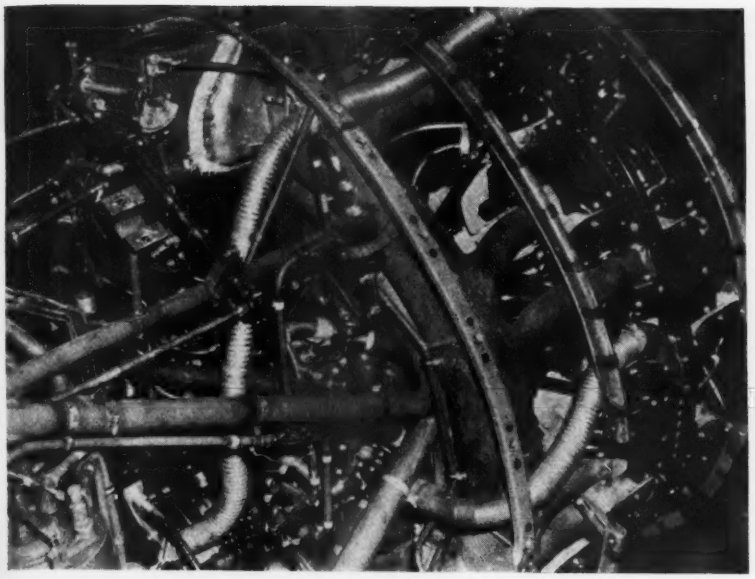


Fig. 7. An undesirable type of blast tube for cooling aircraft engine-driven generators.

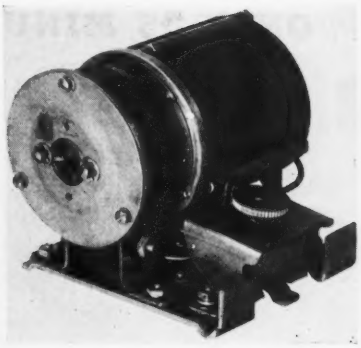


Fig. 8. Carbon pile voltage regulator.

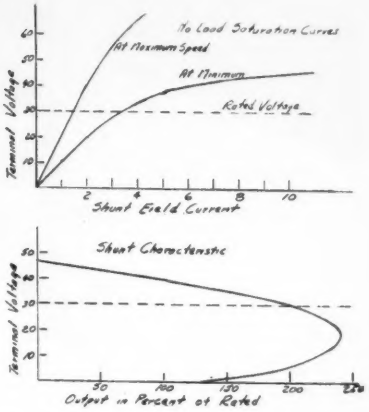


Fig. 9. Characteristics of a typical generator.

respect to field current under various conditions.

Requirements for field current have been standardized so that one regulator is suitable for any standard generator from 1.5- to 9-kw. rating. These regulators will vary the resistance in series with the field from $^3/_4$ to 60 ohms on a change in impressed voltage of 0.3 volt or 1 per cent of the regulated value.

Besides holding voltage constant, these regulators govern the division of load between generators that operate in parallel. This is done with a separate voltage coil that assists or counters the voltage coil as needed to make the generator carry its share of the total load. This control is in response to a voltage drop in an external resistor, which is in the negative lead of the generator, as shown in Fig. 10. This resistor develops a voltage drop of 0.5 at rated load of the generator. The generator rating and resistor rating should coincide. This permits proportionate paralleling of generators having different ratings.

At 200 amp., this resistor radiates 100 watts of heat; the dissipation of this heat deserves careful consideration on the part of the aircraft manufacturer. However, the most important consideration is the grounding connection. Any resistance in this connection will add to the total resistance at the point of control. In turn, this will cause a drop of potential of 0.5 volt at less than rated current. Therefore the generator connected to this resistor will not carry its share of the load. If there is an installation error in one resistor, it should be removed or an equal error made in the others.

The paralleling control would be more effective if a higher voltage drop were used, but this higher loss would also be wasted power. The 0.5-volt drop is adequate when properly used, and the cost in power is more than compensated by the increased generator capacity that is available to the entire system.

There has been some criticism of the use of an external series resistor when it is known that most generators have an internal series field winding. The potential loss in this field is usually more than 0.5 volt, and it is "free," since it contributes to generator performance. However, to use this method, all generators would have to use series fields, and, further, these field windings should have the same resistance. This is restrictive for the generator designer, and use of the external resistor probably results in an overall gain of lighter and more efficient generators.

The Battery

The battery, the power reservoir of the electrical system, is a collection of 2-volt cells. Each cell contains a positive and negative lead plate immersed in sulphuric acid. Three-, six-, and twelve-cell batteries are used in automotive and aircraft batteries. The latter are designed more closely to limiting conditions and this decreases

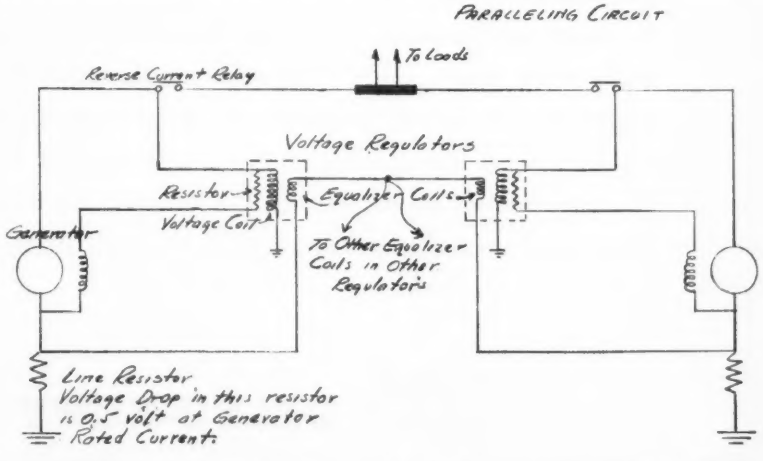
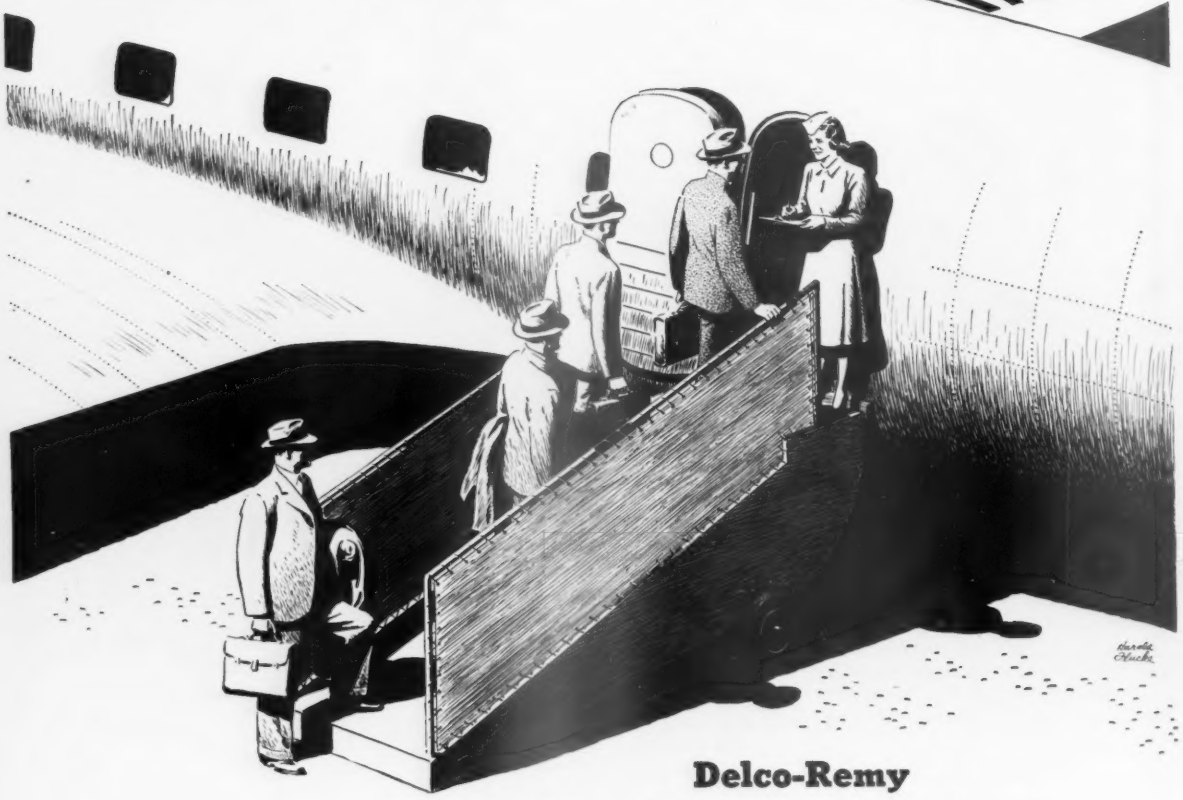


Fig. 10. If current delivered by a generator is not a proportionate share of load, voltage drop in line resistor will not be equal. As a result, current will flow through equalizing coils and will adjust voltage regulators until no equalizing current flows.

ONLY 85 MINUTES AWAY

1921



Delco-Remy
Aircraft Electrical Equipment

The sales maps of tomorrow already are being redrawn. Man given wings is not fettered by obstacles on the earth's surface, and sales outlets once contacted occasionally are now only 85 minutes away by fast plane. Global salesmanship will open new markets for new products. ¶ Delco-Remy aircraft electrical equipment will be ready to carry out its assignment on these planes of the future . . . dependably and adequately. Together with other Delco-Remy precision parts and aircraft products, it is serving today on great numbers of bombers, transports and pursuit planes. ¶ Delco-Remy's broad background of experience in the design and manufacture of dependable electrical equipment will serve well in the postwar advance of new sales frontiers.

ARMY E NAVY

DELCO-REMY

WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION

weight at a cost of decreased life. The battery shown in Fig. 11 needs careful maintenance; therefore, the aircraft manufacturer must so install it that it is accessible for servicing and readily removable for recharging or other maintenance. During operation in cold climates, the battery must be kept warm to deliver its rated output; it is most easily kept warm by removing it from the airplane and storing it in the hangar.

The performance curves of a standard aircraft battery are shown in Fig. 12. It will be noted that the battery does not begin to deliver power until the system voltage has dropped to 24. Therefore, the battery will not begin to share the load until the generators are greatly overloaded. During normal flight, then, the batteries do not contribute anything to the load except the absorption of motor starting surges. These starting surges are of short (less than 1 sec.) duration, and they are usually completed before the voltage regulators of the generators can act.

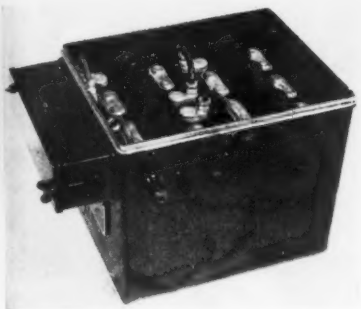


Fig. 11. Twenty-four-volt lead and type of storage battery for aircraft.

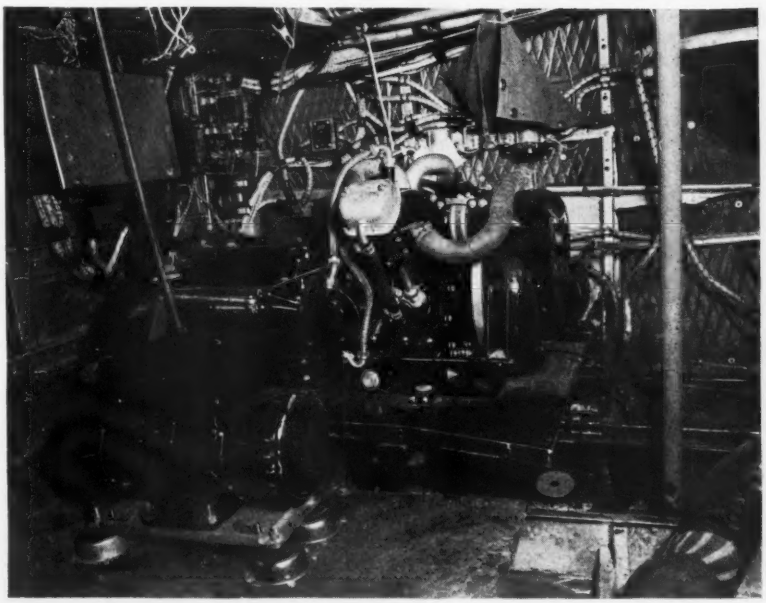


Fig. 13. Installation of a 5-kw. auxiliary power plant (engine-generator unit).

For ground operation the batteries will deliver power initially at 24 volts, this terminal voltage dropping slowly to about 22 and then rapidly to 18 and lower. Therefore it has been common practice to see electrical specifications requiring performance at such wide limits as 30–22 volts. The first value assumes failure of the voltage regulator and the second is based on ground operation.

Use of the ground and air-borne power units eliminates the need for this extreme spread. This wide variation in voltage limit is a severe handicap to the electrical designer, and it increases the weight of equipment. It must perform at 22 volts and it must not overheat at 30 volts. Both of these increase weight over that required for a narrower range such as 28–26 volts.

Charging Problems

During the charging operation the battery will gas; the vapor presents two problems. First, the vapor is corrosive; second, it can be an explosion hazard. To counteract both of these the battery case is vented. A small positive pressure is put on the higher vent, and a jar containing an alkaline soda receives the vapor from the other vent. Thus the acid is neutralized.

The positive pressure at the inlet must exist under all conditions of flight or the acid vapor will reverse its flow and damage the aircraft structure at the new "exit." It has been demonstrated that the acid contents of two batteries thus deposited by reverse flow on the structure of an airplane can cause 1,600 manhours of repair work.

Auxiliary Units

Storage of 1 kwh. of electrical energy in a battery costs approximately 100 lbs. This weight, plus low temperature and low voltage performance, has encouraged the development of a substitute, the engine generator unit or the auxiliary power plant. A widely used example is shown in Fig. 13. This unit weighs 125 lbs. It has a continuous rating of 5 kw. and a 5-min. rating of 7.5 kw.

At the 5-kw. rating it consumes a little more than 5 lbs. of fuel per hour. Therefore, 5 kwh. of energy cost 125 plus 5 (130) lbs., or 26 lbs. per kw. This is approximately four times the effectiveness of a battery. As the need for more power arises the weight ratio will be still more favorable for the auxiliary power unit.

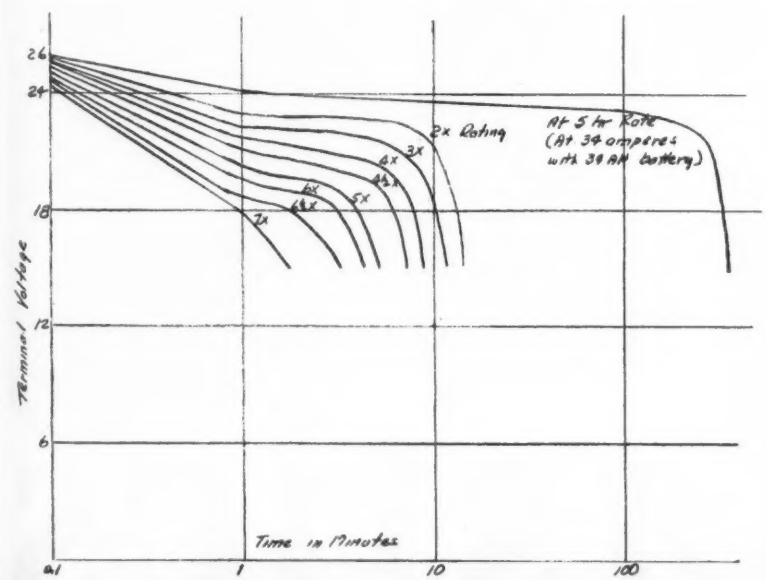


Fig. 12. Characteristic discharge curves of aircraft lead acid storage batteries.

Vinylite

TRADE-MARK

NO AIR NEEDED—

THE PRESSURE HELD!

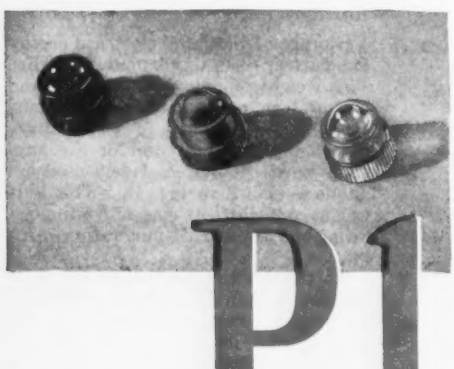
THEY DID IT FOR AN EXPERIMENT—drove with a loosened tire valve! But the tire was firm after several days! *The pressure held,* for the valve cap* being tried was molded of VINYLITE elastic plastics. These caps form their own threads when first pressed on the valve stems—their elastic tension holds them fast and firm, helping keep air in and keeping grit and moisture out. What's more, they come in colors that match or complement the colors of the cars.

These valve caps are small items, but they ably show the outstanding performance of products made of VINYLITE elastic plastics. Besides elasticity, these materials have a whole galaxy of important properties. They're tough, long-lived, and non-flammable. They're highly resistant to abrasion, moisture, and most chemicals. And VINYLITE elastic plastics come as both molding and extrusion compounds, as flexible sheeting and film, as compounds for calendering cloth and paper—in all colors—transparent, translucent, and opaque.

For full information about VINYLITE elastic plastics and their possibilities in your own production program, write for Booklet P1-17.

*Made by Electric Auto-Lite Company, Bay Manufacturing Division.

BAKELITE CORPORATION
Unit of Union Carbide and Carbon Corporation
UCC
30 EAST 42ND STREET, NEW YORK 17, N.Y.



Plastics

The advantages of using such auxiliary units for primary electrical power are often cited. There are many, but until such methods result in lower weight they should not be considered. The commonly used auxiliary engines weigh approximately 5 lbs. per hp. Much development of higher ratings will be needed to reduce this value to even 2 lbs. per hp. The main engine is the preferred source, because *additional* power can be taken from it at a cost of less than 1 lb. per hp. At the same time, fuel economy must be considered. At its best point the auxiliary engine will require 0.6 lb. per hp. hour. Most of the time it will operate at reduced power and rated speed and may consume 2.0 lbs. per hp. hour. Again, the main engines will require only 0.4 lb. per hp. hour.

Before auxiliary engines can justify a claim for use as primary power they must meet a severe specification, since they should weigh less than 1 lb. per hp. and should consume less than 0.4 lb. per hp. hour of fuel at light loads.

Electrical Load Equipment

Devices that consume electrical power can be divided into many categories, but the following will serve for this discussion: (1) lighting, (2) radio, (3) heaters, (4) solenoids, (5) motors, and (6) controls.

Lighting

Electrical power has no competition for the lighting and radio loads. Therefore, this type of load can be dismissed rather quickly with the one comment that designers of lighting equipment are constantly striving for improvement.

The large passenger transports that will follow the war will need better lighting than that previously used. A great deal of work is being done on instrument and cockpit lighting. It has been difficult to find a solution that was practical, that was equally satisfactory to young and old eyes, and that was an economical addition to the instrument panel.

Radio

With respect to radio equipment, the designer must design structures that have minimum weight and space. A keener appreciation of the seriousness of aerodynamic losses resulting from many antennas will come with longer usage. These shortcomings of weight, space, and drag are more than repaid by the assistance that radio has given to the accomplishment of military missions. A large portion of the electrical load in the military airplane is used for radio.

Heaters

Electrical heating seems a poor choice when so much heat is thrown away as waste. However, weight is the one factor on which all else is judged, and for localized heating the electrical solution is often best. Applications

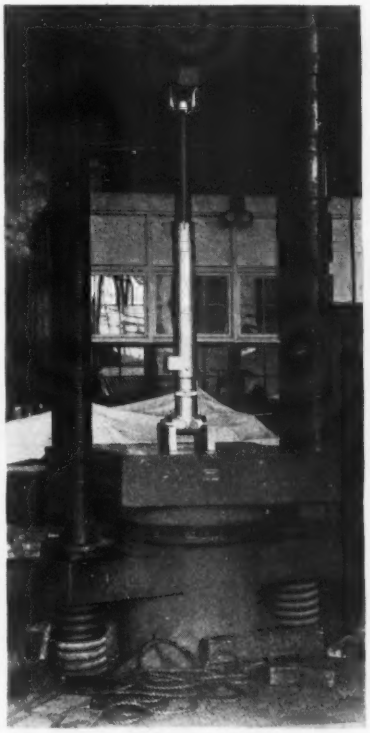


Fig. 14. Motor-driven linear actuator using a ball-bearing nut. Note small size of motor and gear box, which results from the use of an efficient screw device.

that have been used are spot heaters on guns and cameras, clothing, windshields, and propellers. In each case it is not difficult to see why electrical heating has been used. The energy can be transmitted to the spot with little loss and weight and, once there, it can be applied effectively. Because of the fact that it can be applied with little weight and high efficiency, the possibility of using electrical heating for wing deicing is being seriously considered.

Solenoids

The solenoid is the simplest device for converting electrical energy to mechanical movement. It is ideal for short motions—i.e., to $\frac{1}{2}$ in. For this reason it is often used to latch or unlatch other mechanisms and for remote control of valves, switches, and similar mechanisms. It has several advantages: (1) Power required is quite low; (2) response is immediate; (3) it has only one moving part; (4) close mechanical tolerances are not needed; (5) cost is low; and (6) construction is simple and rugged.

Motors

Motors have two common applications—pump and actuators. When used to drive a pump, the electrical generators and motors become simply a coupling between the engine and the pump. The need for such a coupling must be justified on a weight basis, but there are several reasons for wanting such an installation: (1) There is no space for an additional accessory on the engine; (2) the desired location of the pump may be at considerable distance from the engine; (3) the weight of motor and wiring may be less than the equivalent tubing for the pump output; and (4) electrical wiring is less vulnerable to gunfire.

Great progress has been made in the design of actuators. The electric actuator is the counterpart of the hydraulic piston. Like the solenoid, the actuator converts electrical energy into mechanical motion. This progress can be credited to the adoption of the ball-bearing screw shown in Fig. 14. With this construction, the overall efficiency of such an actuator is 70–80 per cent, instead of the 10–15 per cent that formerly prevailed. This higher efficiency permits great reduction in motor size and rating and power consumption. Since the efficiency exceeds 50 per cent, the actuator is reversible and the load can reverse the motion. To counteract this, it has been necessary to add a small disc brake or clutch that locks the actuator within the motor. Since it is installed in the motor, the torque needs of the brake are low and the weight penalty is a matter of only 1–4 oz., depending on the motor rating. With this brake there is no drift of load setting.

The actuator can be divided into six parts. Three of these are primary and the others are control elements: (1) motor, (2) gear reduction, (3) screw jack, (4) limit switches, (5) torque limiters or other stops, and (6) motor brake and solenoid.

There are several advantages of the electric actuator that can be exploited:

(1) Efficiency. As noted, the high efficiency permits a reduction of motor size and rating. It also eases the problem of finding an emergency alternate. For example, manual effort is reduced. Too, the load itself can extend the actuator as in landing gear applications.

(2) The weight of electric actuators is competitive with other types. Further, when the entire system is analyzed there can be a considerable saving in weight. This considers the lighter weight in transmission and the potential elimination of a second accessory system.

(3) The electric actuator is not adversely affected by temperature.

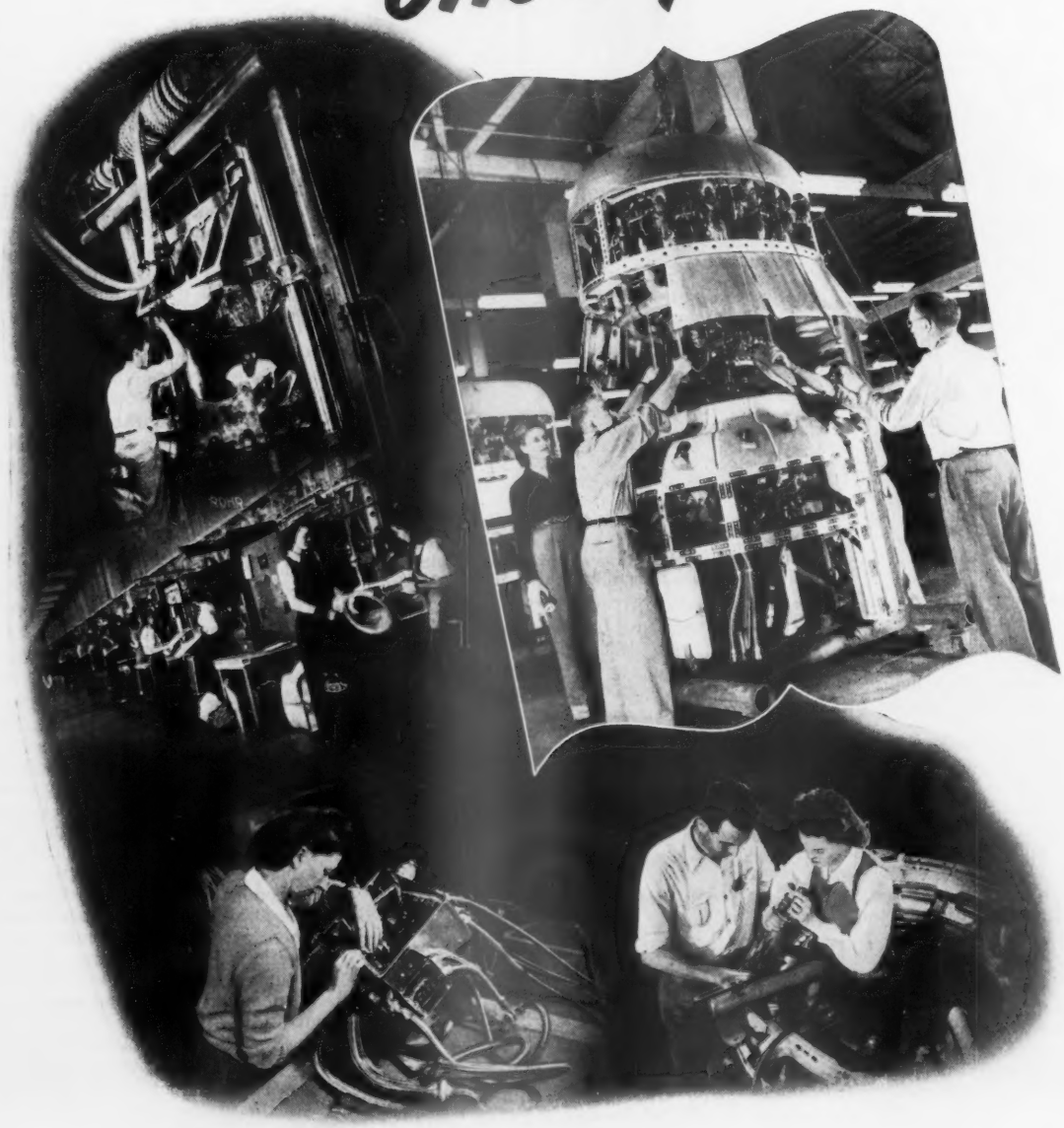
(4) There is no "drift" of the actuator, since the motor brake locks the assembly in place.

(5) When a complicated control requirement, such as "multiposition," is encountered, the electric actuator is supreme.

Paralleling the actuator, the electric servo has been under development. An electric motor is completely inadequate for servo applications because its speed is relatively inflexible. With field control a 2/1 speed range is practical. With speed and armature control a 4/1 range is practical. By using a motor generator set with the motor a compara-

(Continued on page 91)

THOUSANDS OF OPERATIONS BUT JUST one big result!



ROHR
AIRCRAFT
CORPORATION

The sleek cover of a Rohr-made motor nacelle hides over 5000 operations of parts manufacturing, electrical installation, motor preparation and final assembly. It is one of the war's big tasks, brought by Rohr from a time-consuming "custom built" operation to assembly line efficiency.

Every Rohr production facility is employed in the task of defeating Japan—*and will be to war's end*—the one big result America seeks!

BUY MORE BONDS ★ HELP FINISH THE FIGHT

ROHR AIRCRAFT CORPORATION, CHULA VISTA, CALIF. • HELPING TO WRITE THE STORY OF TOMORROW

Institute News

Posthumous Awards for General Mitchell

On April 25 the Senate passed and sent to the House bills honoring the late William Mitchell of the Army Air Corps. One bill provides that he be promoted posthumously to the rank of Major General. In the other bill he would be awarded posthumously the Congressional Medal of Honor.

Gifts to the Aeronautical Archives

C. D. Hanscom added to his previous generous gifts 85 historical photographs, more than 100 pamphlets, periodicals, and government publications, and a sample of fabric from the airship "Goodyear." Dr. Edward P. Warner sent ten French and German books, including *Rapport sur les Traveaux de la Commission de l'Armée Pendant la Guerre, 1914–1918* (*Aéronautique*), Paris, 1919, and other books on air transport and military aeronautics. These are in addition to previous generous gifts by Dr. Warner.

Volumes 1 and 2 of his *British Aircraft* were given by R. A. Saville-Sneath. An identification badge of the National Advisory Committee for Aeronautics' Engine Research Laboratory in Cleveland was received from Edward R. Sharp. A variometer used by the Army Air Forces in 1916 was received from Sgt. William S. Friedman. Mrs. Bella C. Landauer gave two cork airplane coasters.

Ralph M. Eastman of the State Street Trust Company, in Boston, sent a new bank check of aeronautical design and an Aviation Week sticker. James C. Stephen, of Boston, gave two volumes of *N.A.C.A. Reports*. John P. V. Heinmuller sent a Lindbergh medal of 1927, made by Henri Teterger of Paris. Aeronautical periodicals were received from the Propeller Division of the Curtiss-Wright Corporation, Eclipse-Pioneer Division of the Bendix Aviation Corporation, Ranger Aircraft Engines Division of the Fairchild Engine and Airplane Corporation, C. L. Morris, and Jerome Lederer.

A bibliography of material in the Aviation Department library of the San Francisco Chamber of Commerce was received from that office through the courtesy of Kenneth R. McDonald. The Glendale Rocket Society sent its first yearbook—1943–1944. The International Association of Machinists, Lodge 151, Seattle, sent a back file of its *Aero Mechanic* for 1944. A back file of its *Publicación* for 1944 was received from the Departamento de Aeronáutica Civil of Mexico. The Royal Canadian Air Force sent its two-volume *Manual of Air Navigation*. A back file of its *Foreign Air News Digest* was received from the Air Transport Information Division of the Civil Aeronautics Board, together with other publications. A bound volume of *The Southernaire* for 1944 was sent by Southern Airways, Inc.

Petitions and briefs relating to applications for new air routes and extensions of existing routes before the Civil Aeronautics Board were received from the American South African Line, Inc.; Braniff Airways, Inc.; Eastern Air Lines, Inc.; Mid-Continent Airlines, Inc.; Pan American Airways, Inc.; Royal Dutch Air Lines and Royal Netherland Indies' Airways; Transcontinental & Western Air, Inc.; U. N. Airships, Inc.; and United Air Lines, Inc.

Other gifts were received from Aeronca Aircraft Corporation; Curtiss-Wright Corporation; Doremus & Company; Ethyl Corporation; Dr. Alexander Klemin; Menaugh-Dutterer Company; Missouri Department of Resources and Development; National Aviation Trades Association; National Research Council; Ohio State University Engineering Experiment Station; Railway Express Agency, Inc.; the U.S. Army Air Forces; Navy Department; Office of War Information; Bureau of Public Relations of the War Department; and the House Document Room.

In ceremonies held April 22 at the Case School of Applied Science, in Cleveland, Glenn L. Martin *(left)*, President of The Glenn L. Martin Company, was presented an honorary degree of Doctor of Engineering by President William E. Wickenden *(center)*. At the right is Carl F. Prutton, Head of the Department of Chemistry at the school.

I. A. S.

Special Meetings Schedule

1945

August 16–17, 1945
LOS ANGELES MEETING

October 4–5, 1945
DETROIT MEETING

October 26, 1945
WASHINGTON MEETING

November 16, 1945
DAYTON MEETING

December 17, 1945
WRIGHT BROTHERS LECTURE, Washington, D.C.

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to

The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

Corporate Member Changes Name

The corporate title of Westinghouse Electric & Manufacturing Company, a Corporate Member of the Institute, has been changed to Westinghouse Electric Corporation.

Sections and Branches

Detroit Section

On March 26 a joint meeting was held by the Detroit Section with the Engineering Society of Detroit, Inc., in the auditorium of the Horace H. Rackham Educational Memorial. J. Carlton Ward, Jr., President and General Manager of Fairchild Engine and Airplane Corporation, spoke on "Aeronautical Engineering Research, an Instrument of National Policy." The address dealt with technical development as a key to American air power, with plans to be made for a postwar national-defense program for the aircraft industry and with the relationship of research and technologic developments in aviation to the national economy.

New York Section

The following officers of the New York Section were elected at a business meeting, held on April 23 in the Auditorium of the McGraw-Hill Building: Chairman, Jerome Lederer, Chief Engineer and Assistant General Manager of Aero Insurance Underwriters, Inc.; Vice-Chairman, George Brady, Head of the Experimental Division of Curtiss Propeller Division of the Curtiss-Wright Corporation; Secretary-Treasurer, R. Dixon Speas, Assistant to Vice-President of Engineering of American Airlines, Inc. The Executive Committee consists of Charles Tilgner, Chief of Aerodynamics and Flight Test for Grumman Aircraft Engineering Corporation; C. Hart Miller, Vice-President and Divisional Manager of Republic Aviation Corporation; Donald Lampland, Senior Staff Engineer of the Atlantic Division of Pan American Airways System; Frederick K. Teichmann, Professor and Chairman of the Department of Aeronautics of New York University.

Following the business meeting, Alfred Marchev, President of Republic Aviation Corporation, gave a talk on "Problems Associated with Simplified Low-Cost Airplanes." In his talk, Mr. Marchev emphasized that by applying the fundamentals of engineering production, the volume production of metal units for aircraft can be simplified and the costs substantially reduced. He showed that by redesigning and retooling for the stabilizer for the Republic postwar "Seabee" Amphibian, the number of parts could be reduced from 42 to ten and that in static tests the new stabilizer satisfactorily supported 110 per cent ultimate load. He described similar experimental designs of other parts which resulted in similar economies in production time and cost.

Actual structures were exhibited for the information of members and guests present at the meeting.

Phoenix Section

Following a dinner meeting on April 20, the members of the Phoenix Section were conducted through the plant of the AiResearch Manufacturing Company. Thirty-six members and guests who participated in this inspection were escorted by representatives of the company and took part in the interesting program prepared for the visitors.

Washington, D.C., Section

At a meeting on May 1 in the United States Chamber of Commerce Building, L. Welch Pogue, Chairman of the Civil Aeronautics Board, presented a paper on "International Aviation." He gave an outline of the history of agreements referring to international aviation and analyzed the significant developments at the recent conference in Chicago. In that connection he spoke particularly about the treaty regarding a permanent convention for international civil aviation now before Congress for ratification and also described the three executive agreements known as the Interim Agreement, the Transit Agreement, and the Five-Freedoms Agreement.

Active discussion from the floor took place following Mr. Pogue's presentation. British members and guests attending the meeting included nine representatives of various British government offices and manufacturing companies. Also among the guests were 17 representatives of U. S. Government departments and domestic airlines.

The following committees were appointed by the Chairman: Program, Lt. Comdr. J. R. Hoyt, Dean Triplett, and M. B. S. Spaulding; Membership, Joseph Stout and Major R. R. Hajek; Public Relations, Wayne Parrish, W. P. Redding, and Katharine Stinson.

Wichita Section

Following a dinner, a meeting was held on April 13 at the University of Wichita Auditorium. Dr. O. O. Fisher, of Detroit, gave a lecture in the form of a running commentary about a series of films taken during the expedition to photograph the volcano Paracutin in Mexico. The expedition, of which Dr. Fisher was a member, studied the volcano from the air and from the ground, making colored motion pictures and slides. A paper was also presented by R. Williams, of the Wichita Division of Boeing Aircraft Company. Mr. Williams spoke about photographic records of flight-test data.

University of Alabama

On April 12 a meeting was held in the new Engineering Building. Professor C. N. Gaylord, who has been on leave of absence while working with a group of engineers at Goodyear Aircraft Corporation, led an informal discussion about design and development work in the aircraft industry.

During a business session that occupied a part of the meeting time, Earl W. Karm was elected Secretary-Treasurer in place of Herman E. Sewell, Jr., who has been away from school because of illness.

Illinois Institute of Technology

At a business meeting on April 20 plans were discussed for the presentation of technical papers to be entered in competition for the Institute's Student Branch awards. In addition to the Institute's awards, the Branch plans to give several of its own awards for selected technical papers.

Indiana Technical College

A special election took place on March 19 at which Milton LaCoss was nominated and elected by acclamation for the office of Vice-Chairman to succeed Allison Caudill, who left to enter the armed services.

A combined technical and business meeting on April 9 was addressed by Leonard Cancler, a Student Member, on the subject of "Control of Vibration in Aircraft." The speaker discussed the difficulties caused by vibration in aircraft and means of reducing vibration. The film titled *Building a Bomber*, obtained from The Glenn L. Martin Company, was shown.

Iowa State College

H. C. Thom, State Climatologist for Iowa, addressed a technical meeting of the Iowa State College Branch on April 12. His subject was "Weather and Climate for Flying."

At a technical meeting on April 26, Charles Byrne, an engineer connected with Solar Aircraft Company, spoke on "The Engineer in Industry."

University of Kansas

On April 26 the films *Target Germany, This is Your Enemy,* and *R.A.F. in Action* were shown at a business meeting of the University of Kansas Student Branch.

University of Michigan

The February meeting of the University of Michigan Branch was held on February 14, at which Prof. L. C. Maugh, of the University of Michigan Civil Engineering Department, discussed lighter-than-air craft.

On March 14 Prof. F. Pawlowski, of the Aeronautics Department of the University, spoke on "Benjamin Franklin as the Father of American Aeronautics." Dr. A. M. Kuethe, Acting Chairman of the Department of Aeronautical Engineering, was elected Faculty Advisor for the Branch.

A joint meeting with the local chapter of the American Society of Mechanical Engineers was held on April 18. G. R. Graetzer, of the Aeronautical Research Department of Wayne University, gave a talk about helicopters. The talk was illustrated by a collection of film strips showing tests and flights of helicopters.

New York University

Meetings of the New York University Branch held on April 10 and 24 were limited to the showing of motion-picture films and informal discussions of the future programs: April 10—the film *Army Air Forces Report*, April 24—the Boeing Aircraft Company film *Fortress of the Sky*.

University of Notre Dame

An informal meeting was held in Bronson Recreation Hall on March 21. The Chairman, Clifford Marks, gave a brief discussion about the activities for the coming semester.

On March 28 a joint meeting was held with the University of Notre Dame Branch of the American Society of Mechanical Engineers, at which Jay Bolt, of the Bendix Aviation Corporation, gave a lecture based on a cutaway model of the Stromberg injection-type carburetor. A short business meeting followed the lecture.

University of Oklahoma

At a technical and business meeting on April 9, W. O. Smith, Assistant Professor of Mechanical Engineering at the University, gave a talk on "Firearms." A discussion was held concerning plans for competition for the Institute's Student Branch awards. It was decided that papers would be submitted by eligible members and judged by the Faculty. The film *Aerodynamics* was shown.

Rensselaer Polytechnic Institute

The following officers were elected at a business meeting on March 24: Chairman, H. DeGroff; Treasurer, W. Z. Myers; Secretary, M. T. Kehoe. The motion picture *Flight Characteristics of the P-38* was shown.

On April 13 the motion pictures *Airplane Construction* and *Static Testing* were exhibited.

Spartan College of Aeronautical Engineering

At a business meeting on April 5 Ellen Channel was elected auditor. A review was given of the rules and operating principles of the Branch for the benefit of new students.

At a business meeting on April 19 Don Emmick was made Program Chairman, and on April 28 there was a general discussion of rules and regulations and other business matters.

Virginia Polytechnic Institute

The films *Lockheed Lightning P-38* and *Cannon on Wings* were shown at a technical meeting on April 11.

On April 25 a smoker was held at which an aircraft-identification contest was conducted by Professor Seltzer. Pictures of 40 American and foreign airplanes were flashed on the screen. The winner of the contest was R. S. Leisner, who received a French curve as an award.

News of Members

William R. Enyart, President of Simmonds Aerocessories, Inc., has been re-elected as President of the National Aeronautical Association and was also made Chairman of the Board.

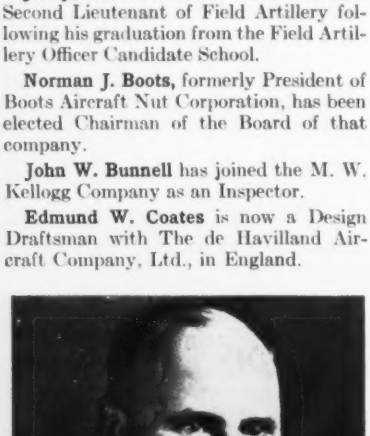
Joel R. Baker, Jr., has joined the Staff of the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics, as an Engineering Test Pilot.

Joseph Becker has been commissioned a Second Lieutenant of Field Artillery following his graduation from the Field Artillery Officer Candidate School.

Norman J. Boots, formerly President of Boots Aircraft Nut Corporation, has been elected Chairman of the Board of that company.

John W. Bunnell has joined the M. W. Kellogg Company as an Inspector.

Edmund W. Coates is now a Design Draftsman with The de Havilland Aircraft Company, Ltd., in England.



Dr. Zay Jeffries, Vice-President of the General Electric Company and Technical Director of the company's Lamp Department, has received the Certificate of Merit of the Franklin Institute of Philadelphia. He received the award for his "meritorious contributions to the science of metals."

John O. Emmerson has accepted an engineering commission with the Royal Canadian Electrical & Mechanical Engineers.

William R. Enyart, President of Simmonds Aerocessories, Inc., was re-elected President of the National Aeronautics Association and was also made Chairman of the Board.

Pollard Garrison has been appointed Technical Consultant to the Army Air Forces.

Irwin R. Goldsmith has been commissioned an Ensign in the U.S. Naval Reserve.

Claude Horton has joined Huck Manufacturing Company as a Field Engineer.

John J. Hospers, formerly Field Service Manager for Airplanes, has been named Sales Manager of the Chance Vought Aircraft Division of United Aircraft Corporation.

Dr. Zay Jeffries, Vice-President of General Electric Company and Technical Director of the Company's Lamp Department, received the Certificate of Merit of The Franklin Institute of Philadelphia. He received the award for his "meritorious contributions to the science of metals."

Edwin W. Johnston has joined the Engineering Department of North American Aviation, Inc., as Aerodynamicist "B."

William D. Laird has been appointed Research Engineer with Turbo Research, Ltd.

G. deFreest Larner has been appointed Assistant to the President of H. K. Porter Company, Inc.

Dr. George W. Lewis, Director of Aeronautical Research of the National Advisory Committee for Aeronautics, has been elected to Membership in the National Academy of Sciences. Dr. Lewis is the sixth Aeronautical Engineer admitted to membership in this selective organization of Scientists.

H. Yale Mageoch has been appointed Chief Engineer of Electric Service Manufacturing Company.

Leo Newman has joined Otis Elevator Company as Layout Draftsman.

Perry A. Pepper has joined Edo Aircraft Corporation as an Aerodynamicist.

William P. Redding was re-elected Treasurer of the National Aeronautics Association.

Albert C. Reed has established his own office as an Aviation Consultant.

James D. Robinson has been appointed Field Installation Engineer with the Pratt & Whitney Aircraft Division of United Aircraft Corporation.

James G. Sawyer has been elected Vice-President and Chief Engineer of the Buffalo Turbine Corporation.

Sumner Sewell has been elected President and Director of American Export Airlines, Inc.

Jerome Steffens is now an Aeronautical Engineer in Stress Analysis with Kellett Aircraft Corporation.

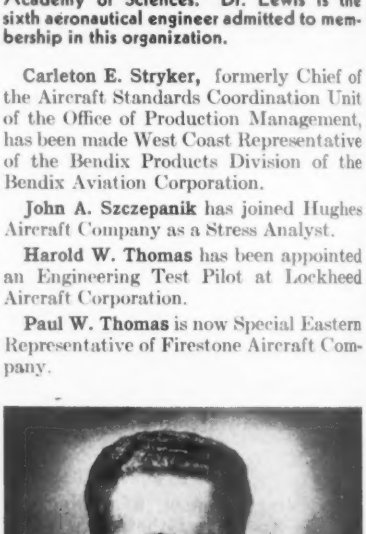
Dr. George W. Lewis, Director of Aeronautical Research of the National Advisory Committee for Aeronautics, has been elected to membership in the National Academy of Sciences. Dr. Lewis is the sixth aeronautical engineer admitted to membership in this organization.

Carleton E. Stryker, formerly Chief of the Aircraft Standards Coordination Unit of the Office of Production Management, has been made West Coast Representative of the Bendix Products Division of the Bendix Aviation Corporation.

John A. Szczepanik has joined Hughes Aircraft Company as a Stress Analyst.

Harold W. Thomas has been appointed an Engineering Test Pilot at Lockheed Aircraft Corporation.

Paul W. Thomas is now Special Eastern Representative of Firestone Aircraft Company.



Theodore P. Wright, Administrator of the Civil Aeronautics Administration, has been awarded the Army's "Commendation for Exceptional Civilian Services." This is the highest honor which the Army can confer on a civilian. The decoration was given to Mr. Wright in recognition of his services on behalf of the nation's aircraft-production program while he was connected with the War Production Board.

Kenneth L. Thornbury has been commissioned an Ensign in the U.S. Naval Reserve.

John E. Viscardi is Director of Research and Development at Davis Engineering Corporation.

Ivor B. Yassin has joined Central Aircraft Corporation in charge of structures.

Nicholas Ziino is now a Detail Designer with Grumman Aircraft Engineering Corporation.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Cairns, Edmund Burke, Stress Engineer, The Glenn L. Martin-Nebraska Co.

Campbell, Paul Andrew, Col., U.S. Army Air Forces.

Chmel, Josef K., General Manager, Prenco Progress and Engineering Corp. (Canada).

Collins, Millford E., B.S. in Ae.E.; Lt., U.S.N.R.

Darby, Robert A., Sc.M. in Ae.E.; Head, Aerodynamics & Flight Test Engineering Div., Airplane Div., Curtiss-Wright Corp.

Fischel, Joseph Robert, Major, U.S. Army Air Forces.

Hall, Theodore Parsons, M.S. in E.E.; Chief Development Engineer, Consolidated Vultee Aircraft Corp.

Nebesar, Robert John, Dr. of Eng.; Vice-President-Chief Engineer, Universal Moulded Products Corp.

Pappas, Costos Ernest, Sc.M. in Ae.E.; Chief of Aerodynamics, Republic Aviation Corp.

Rowe, Norbert Edward, B.Sc.; Director of Technical Development, Ministry of Aircraft Production (England).

Welling, Omer, Chief, Flight Analysis Section, C.A.A.

Wood, Carlos, M.S. in Ae.E.; Chief, Preliminary Design Section, Douglas Aircraft Co., Inc.

Zimmerman, Charles Horton, B.S. in E.E.; Consulting Engineer, United Aircraft Corp.

Elected to MEMBER Grade

Beck, Clarence Herbert Edward, B.S. in M.E.; Administrative Asst. Engineer, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp.

Boland, Einar John, B.S. in E.E.; Sales Manager, Aeronautic Instruments, General Electric Co.

Buttner, H. H., B.S. in E.E.; Vice-President, Federal Telephone & Radio Corp.

Cashman, Jeremiah, Aero Fitter Grade I, Instructor, Defence Forces (Ireland).

Covington, Carl Ashby, Aeronautical Engineer, Bureau of Aeronautics, U.S. Navy Dept.

Glassco, James Brinton, B.S. in M.E.; Strength Engineer, Douglas Aircraft Co., Inc.

Hackman, Kenneth Vernon, General Manager, Chief Installation Engineer, Stearns Aeronautical Products Co.

Haddon, Mathew Carl, B.S. in Ae.E.; Project Engineer, Lockheed Aircraft Corp.

Hauck, Vernon Daniel, B.S. in E.E.; Chief Engineer, Friez Instrument Div., Bendix Aviation Corp.

Kern, Paul James, Sr. Instructor, Keesler Field, U.S. War Dept.

Larson, John Winegar, B.S. in M.E.; Chief Engineer, Consolidated Vultee Aircraft Corp.

McElroy, Richard Hamilton, B.S. in E.E.; Asst. Project Engineer, Boeing Aircraft Co.

Noble, John Martin, A.B.; District Aviation Manager, Walter Kidde & Co., Inc.

Romaine, Ralph Orie, Experimental Test Pilot, McDonnell Aircraft Corp.

Rylski, O. Z., Flight Lt., O/C of Flight Engineers to Technical Instructor for the Crews, R.A.F.

Schlieben, Ernest William, B.S. in M.E.; Vice-President in Charge of Engineering, York Research Corp.

Smith, Rolland Harold, B.Sc. of Architectural Eng., Chief of Structures, Platt-LePage Aircraft Co.

Srinivasan, N., B.S.; Inspection Supervisor, Hindustan Aircraft Ltd. (India).

Stefano, Nicholas Michael, B.S. in M.E.; Stress Engineer, Kellett Aircraft Corp.

Transferred to MEMBER Grade

Chang, Fred, M.S. in Ae.E.; Sr. Stress Analyst, Eastern Aircraft Div., General Motors Corp.

Chow, Lewis, B.S. in Ae.E.; Jr. Research Engineer, National Research Council (Canada).

Conway, H. M., B.Ae.E.; Associate Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Crawford, Herbert Raymond, B.Ae.E.; Chief Flight Test Engineer, Grumman Aircraft Engineering Corp.

Deal, Paul L., B.S. in M.E.; Liaison Engineer "A," Lockheed Aircraft Corp.

Freitag, Robert Frederick, B.S. in Eng.; Lt., U.S.N.R.

Lee, Harry Park, B.Ae.E.; Asst. Chief Engineer, Universal Moulded Products Corp.

Lemont, Harold Edminston, Jr., B.S. in Ae.E.; Chief Aero. Engineer and Designer, Gazda Engineering.

Murlin, John Anderson, M.E.; Engineering Manager, Helicopter Div., Bell Aircraft Corp.

Stevens, Herbert Howe, Jr., B.S. in M.E.; Member Technical Staff, Bell Telephone Laboratories.

Tsien, Hsue-Shen, M.S. in Ae.E.; Asst. Prof. in Aeronautics, California Institute of Technology.

Veck, Milton F., B.S. in M.E.; Airplane Div., Curtiss-Wright Corp.

Elected to Industrial Member Grade

Byrne, John, Supervisor, The de Havilland Aircraft of Canada, Ltd.

Chandler, Walter George David, Product Engineer, Aircraft Hydraulic Supplies Ltd. (Canada).

Paden, Joseph H., Chief Inspector, Branch Plants, Boeing Aircraft Co.

Vaughn, George A., Jr., B.S.; Vice-President, Casey Jones School of Aeronautics.

Elected to Technical Member Grade

Adams, Donald William, B.S.; Asst. Aerodynamicist, McDonnell Aircraft Corp.

Berwick, Lawrence Henry, Flying Officer, R.C.A.F.

Binding, John Edward, Technical Asst., Bristol Aeroplane Co. Ltd. (England).

Brown, William Richard, Experimental Mechanic, Army Service School, Div. of Douglas Aircraft Co., Inc.

Carr, George Joseph, Lt. (j.g.), U.S.N.R.

Correa, Joary, Lt., Brazilian Air Force.

Grzywinski, Edward, Lt., U.S. Army Air Forces.

Ibach, Charles Winfield, Sr. Service Engineer, Airplane Div., Curtiss-Wright Corp.

Kansu, Yavuz Mehmet, M.S. in Ae.E.; Engineer, The Glenn L. Martin Co.

Kinyon, Norman Oliver, Weight Controller, Weight Unit, Boeing Aircraft Co.

Klegka, Walter E., B.S. in Ae.E.; Aerodynamicist B, Ft. Worth Div., Consolidated Vultee Aircraft Corp.

Lien, Wallace Addison, B.S. in M.E.; Capt., U.S. Army Air Forces.

McLaughlin, Philip Michael, B.S. in Mining Engineering; Engineer, Canadair Ltd.

Smith, Maurice Harold, M.S.; Institute of the Aeronautical Sciences.

Trotter, Leonard Thomas, Group Leader, The de Havilland Aircraft of Canada, Ltd.

Tsao, Chin-Tao, B.S.; Aero. Engineer, Consolidated Vultee Aircraft Corp.

Upton, John, Jr., B.S. in Ae.E.; P.F.C., U.S. Army Air Forces.

Webber, William Gerald, Technical Asst., Bristol Aeroplane Co. Ltd. (England).

Willner, Lewis, B.S. in I.M.; Pvt., Engineering Asst., U.S. Army Air Forces.

Transferred from Student to Technical Member

Belt, Robert Howard, Aero. Engineer, McDonnell Aircraft Corp.

DeMeritte, Frederick James, B.Ae.E.; Aero. Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Evenchik, Marvin Adelson, B.Ae.E.

The inside story of the

Sodium-Cooled Valve

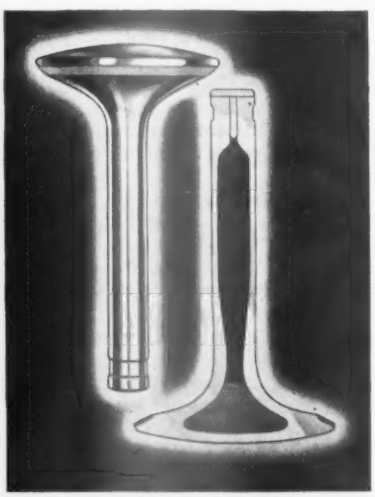
Highlights in development of the valve now universal in aircraft engines of 300 horsepower or more and destined to play an important part in cars and trucks of the future

EVERY now and then an engineering development proves so vitally important, so fundamental, that upon one seemingly small idea the whole progress of an industry may hinge.

Such a development is the Sodium-Cooled Valve, for without it the war planes which today are blasting a victory-trail ahead of our troops might never have been possible.

At the end of World War I it became evident that a radically new type of engine exhaust valve was needed if further strides in increasing output in aircraft engines were to be accomplished. Some of the nation's best engineering talent was put to work with the United States Army Air Corps to concentrate on this problem. Prominent in this experimental work was S. D. Heron, a civilian engineer attached to McCook Field, Dayton. Heron's work led in the direction of a self-cooling valve even though prior experiments in this country and in England with mercury- and water-cooled valves proved unsuccessful.

Inventor Heron, in the course of his experiments, observed that salt baths used in heat-treating operations would readily wet the surface of the pots. This led him to believe that here might be the coolant for which a whole industry was searching.



In operation, the liquefied metallic sodium is agitated by the up-and-down motion of the valve —absorbing heat from the valve head and dissipating it through the valve guide, thence to the cylinder and cooling system.

Filling a hollow-stem valve with a mixture of salts, he made a series of tests under conditions of violent detonation and pre-ignition in the engine. An uncooled valve would have failed completely. But the salt-cooled valve operated "black" instead of red hot, and showed little or no effects from this punishment.

Eaton's Wilcox-Rich Division worked closely with inventor Heron all through this pioneering period. A manufacturing license, granted by the inventor in 1926, was the natural result of this successful collaboration. It was in Eaton's extensive research laboratories that experimentation proved the superiority of metallic sodium (since adopted) to salts as a coolant. And it was there that the Sodium-Cooled Valve, as it is known and used today, was developed commercially.

This is the inside story of the Sodium-Cooled Valve. We at Eaton feel that the contribution made by our engineers two decades ago, plus our mass-production of this complex, precision-made aircraft engine part, give us the right to consider Eaton's aid to the air arm of our military forces as one of the factors contributing in an important way to Victory.

EATON

EATON MANUFACTURING COMPANY • *General Offices:* **CLEVELAND, OHIO**

PLANTS: **CLEVELAND, DETROIT, SAGINAW, MARSHALL, BATTLE CREEK, LAWTON, VASSAR, MASSILLON, WINDSOR (CANADA)**

EATON AIRCRAFT PRODUCTS: *PROPELLER SHAFTS • CRANKSHAFTS • ENGINE VALVES • VALVE TAPPETS • COIL SPRINGS • VALVE SEAT INSERTS • GASOLINE TANK CAPS • FLY WEIGHTS • FORGINGS • ENGINE BOLTS • STAMPINGS • BUSHINGS • RETAINER RINGS • WASHERS • AND OTHER MISCELLANEOUS ENGINE PARTS*

Grose, Gordon Glen, B.Ae.E.; Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Hoyt, Jack McEachron, B.Ae.E.; Aerodynamics Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Laskin, Nathan, B.Ae.E.; U.S. Navy.

Lester, Joseph Thomas, Jr., B.Ae.E.; Ensign, U.S.N.R.

Parchem, John Anthony, B.Ae.E.; Jr. Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Sacks, Alvin Howard, B.S. in Ae.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Tabarini, Bernard, B.Ae.E.; Aero. Engineer, David Taylor Model Basin.

Elected to Affiliate Grade

Bradbury, Robert Wesley, Ph.D.; Sr. Economic Analyst, Dept. of State (Washington, D.C.).

Carrick, Andrew Elmer, Master Scheduling & Statistical Supervisor, The de Havilland Aircraft of Canada, Ltd.

Ginter, Louis Fisk, Tool Processing, Bellanca Aircraft Corp.

Ross, Frank Xavier, Jr., Tool Designer, Ranger Aircraft Engines Div., Fairchild Engine and Airplane Corp.

Ulm, Richard Henry, Draftsman, Taylorcraft Aviation Co.

Necrology

Lt. Gilbert Leonard Shurman

Lt. Gilbert Leonard Shurman, Army Air Forces, a Technical Member of the Institute, died on April 13, 1945. Lieutenant Shurman was born in New York on January 10, 1922. He was graduated from Stuyvesant High School in 1938 and received the degree of Bachelor of Aeronautical Engineering from New York University in April, 1943.

He proceeded directly from college to the armed forces of the United States.

Arthur Jeremiah Sweet

Arthur Jeremiah Sweet, a Member of the Institute and Assistant Airport Engineer, Technical Development Division of the Civil Aeronautics Administration, died on April 26, 1945.

He was born in Marcy, Oneida County, N.Y., on December 20, 1879, and received the Bachelor of Arts degree from Cornell University. He also studied electrical engineering at the Massachusetts Institute of Technology.

Mr. Sweet's business career began in 1903 with Westinghouse Electric & Manufacturing Company, followed by connections with the Western Electric Company, Westinghouse Lamp Company, and Holophane Company. In 1913 he became a partner in the firm of Vaughn, Meyer, and Sweet, Consulting Engineers at Milwaukee, and from 1916 to 1928 operated his own business as a Consulting Engineer in Milwaukee. Mr. Sweet returned to the Westinghouse Electric & Manufacturing Company at Bloomfield in 1928, and in 1936 he established an office in New York as an independent Consulting Engineer. In 1942 he joined the Civil Aeronautics Administration.

Mr. Sweet specialized in lighting, carrying out research and design work in street lighting, railway lighting, and city planning. With the Civil Aeronautics Administration, his work dealt with fundamental studies on the design and use of marker lights for the guidance of airplanes.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aeronautical Engineering Professor—To teach Airplane Design, Airplane structure, and related subjects. Applicants required to have a degree in aeronautical engineering as well as practical experience in the field. Preference given to candidates having advanced degrees. Facilities now under construction and plans for future construction will provide ample opportunity for research, development, and consultation. Rank and salary will depend upon training and experience of applicant. In applying please give brief sketch of personal qualifications, education, and experience. Address reply to Prof. Robert M. Pinkerton, Department of Aeronautical Engineering, A. and M. College of Texas, College Station, Tex.

Wind Tunnel Model Men—Qualified wind tunnel model builders and/or designers for new small company. Desire men with extensive experience in wood and metal model work to close tolerances and in model project organization and planning. All models and instrumentation are for various aircraft companies and aerodynamics laboratories. Airmail complete qualifications and experience to Aerolab Development Company, 1992 Lincoln Avenue, Pasadena 3, Calif.

Professor in Aeronautical Engineering Department—Broad experience in the aviation industry needed. Address inquiries Dean, G. J. Davis, Jr., College of Engineering, University of Alabama.

Aircraft Instrument Engineer—Urgently needed. Top priority. Thoroughly familiar with design and operations of Automatic Pilots. Gyros and similar Robot Control Mechanisms. Submit details and qualifications at once. McDonnell Aircraft Corporation, 1703 Locust Street, St. Louis, Mo.

Structural and Electronics Engineers, Aerodynamicists, Design Engineers, all grades. New, vital project, U.S.N., location New York City. Send complete résumé or call or wire for interview. Statement of availability required. Postwar continuation. Address Dean D. Smith, Fairchild Engine and Airplane Corporation, 30 Rockefeller Plaza, New York 20, N.Y.

Aircraft Engineers—Experienced aerodynamicists; structural designers; senior drawing checkers; static test engineers; layout and detail draftsmen; senior stress analysts; technical illustrators; technical writer. These positions immediately available in critical war work at attractive salaries. Postwar prospects excellent. Applicants must comply with W.M.C. regulations. Address replies giving education, experience, background, age, and draft status to C. J. Libby, Administrative Engineer, Edo Aircraft Corporation, Terminal Building, Flushing, N.Y.

Aircraft Engineers—Positions available in Clifton & Caldwell, N.J., for Tool & Gage Engineers. Also engineers for manufacturing process, production methods, also design engineers, Seniors & Juniors. Manufacturing operation sheet writers, designers, tool & gage; gage analysts, tool & gage draftsmen. Applicants must have Aeronautical Industrial Manufacturing experience. Must have certificate of availability. Call in person or write Employment Office, Curtiss-Wright Corp., Propeller Division, 143 Getty Ave., Clifton, N.J.

Detail and Layout Draftsmen, Stress Analysts, and Design Engineers needed for development work in the Engineering Department. Must be citizen, not employed in essential war industry, or have a certificate of availability from the U.S. Employment Service Office or the War Manpower Commission of your area. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Buffalo, N.Y.; Attention: Director of Engineering.

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Aerodynamicist or Flight Test Engineer—Ability to analyze flight test data on advanced high performance aircraft. Submit qualifications to McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Mechanical Engineer or Physicist—Not subject to draft, experience in product development, research, and testing. Must have sufficient mathematical background to perform calculations in stress and vibration analysis, thermodynamics, aerodynamics, and general mathematics upon own initia-

A PUZZLE FOR OUR SCIENTISTS . . .

Weatherhead

Firsts

Solving Problems for Industry

★ ERMETO FITTINGS

★ Q-A HOSE END FITTINGS

★ BRAZED STEEL FITTINGS

★ HYDRAULIC BRAKE LINES AND BRAKE FITTINGS

★ FIRE-RESISTANT HOSE ASSEMBLIES

★ THE WEATHERHEAD T-RING PACKING

HOW TO SAVE YOU A PENNY

HAVE you thought much about performance of small parts in new peacetime products—and how much these parts cost?

Countless times since 1919 Weatherhead has been assigned the job of saving "a penny a part" for a manufacturer—and has solved the puzzle and delivered a finer part in the bargain. At Weatherhead this kind of thinking begins at the beginning—in the laboratory—where a steadily growing staff is trained to consider engineering, production and marketing factors all as interlocking parts of each job at hand.

One of many examples:—When hydraulic brakes were adopted for the automobile, Weatherhead developed a hydraulic brake line only one-half the size of those previously used, and produced it for less cost to the automotive industry.

That's why we can say, "Look ahead with Weatherhead." We invite you to write our Sales Engineering Department for assistance in solving your postwar parts problems now.

Look Ahead with

FREE: *Write on company letterhead for "Seeds Of Industry"— 24-page illustrated story of Weatherhead facilities and products ready to serve you.*

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND 8, OHIO

Plants: Cleveland, Columbia City, Ind., Los Angeles

Canada — St. Thomas, Ontario

tive. Some knowledge of combustion desirable. Wanted for research staff of well-established aircraft accessory company with good postwar prospects, located on the West Coast. Salary dependent on qualifications and experience. Address inquiries to Box 311, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Chief of Structures, Stress Analysts—Excellent opportunity for qualified men with medium-sized aircraft manufacturer on postwar work. Commercial experience preferred but not necessary. Applicant must comply with W.M.C. regulations. Address inquiries to Box 309, Institute of the Aeronautical Sciences.

Several Aerodynamic Engineers—For important assignments in well-known West Coast aircraft company. Applicants with a broad experience and proven ability will have unusual opportunity to fill key positions in long-term development program. Address inquiries to Box 308, Institute of the Aeronautical Sciences.

Instrument Designer—Medium-size industrial organization offers excellent opportunity. Position will pay top salary. Present and postwar possibilities are unusually attractive. Man must hold an Electrical or Mechanical Engineer Degree, and have knowledge of optics or electronics. He should also have at least four years' practical experience in instrument design. Please write in detail. Your reply will be held in strict confidence. W.M.C. regulations observed. Address inquiries to Box 304, Institute of the Aeronautical Sciences.

Stress Analysts and Aerodynamicists—Required for aircraft design work U.S. Naval Aircraft Prime Contractor. Address inquiries to Box 297, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

Engineers—Aeronautical, Mechanical Electronic Designers, Draftsmen, Checkers; wide variety of interesting work on essential projects. Excellent postwar opportunities. Manhattan location; W.M.C. rules observed. Address inquiries to Box 284, Institute of the Aeronautical Sciences.

Draftsmen—Four or five, wanted by large research and development organization; experienced in the layout of aircraft structural members. Four or five years' experience required; knowledge of stress analysis desired. Experience in wing or fuselage group would prove satisfactory. Address inquiries to Box 282, Institute of the Aeronautical Sciences.

Aerodynamics Engineer—Practical experience wanted by well-known long-established mid-west manufacturer to conduct technical research and market development in ventilating and air-cooling division. Attractive salary for man of ability and ambition. Address inquiries to Box 275, Institute of the Aeronautical Sciences.

Mechanical, Chemical or Metallurgical Engineer, experienced in fabricating and bonding aluminum alloys, to function as project engineer in conversion of copper exchange heat devices to all aluminum construction for aircraft applications. Mid-west location, position permanent. Salary commensurate with experience and ability. Address inquiries to Box 271, Institute of the Aeronautical Sciences.

Contact Man—to aircraft industry, travel mid-west and east representing manufacturer of heat transfer equipment. Engineering and previous contact with aircraft industry desirable but not essential. State background and previous employers and enclose photo. Address inquiries to Box 266, Institute of the Aeronautical Sciences.

Mechanical & Electronic Engineers—Large engineering firm engaged in essential work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

Chief Design Engineer—Graduate mechanical engineer, experienced on automotive radiators, with established AAA-1 high production manufacturer of automotive radiators. Worth-while salary. Sound peacetime future with resumption of automobile production. Write in complete detail. Enclose recent (nonreturnable) photo. Address inquiries to Box 252, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer, B.S. in M.E. (Aero.), Aero. E.—Two years as project engineer, five years as design engineer, and four years of teaching aviation theory and shop. Held Pilot's License. Desires responsible position. Address inquiries to Box 313, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Test Pilot with design, experimental engineering and flight experience desires suitable position doing development work or experimental engineering and/or flight testing. Available immediately. Address inquiries to Box 312, Institute of the Aeronautical Sciences.

Research Analyst and Technical Writer. Twenty-one years' experience, including Patent Law, Medicine, Aeronautics and Internal Combustion Engineer, including LPG. Several years in Engineering Department of Aircraft Manufacturer. Familiar with setting up technical records and systems. West Coast preferred. Address inquiries to Box 310, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Pilot—Graduate engineer over 15 years' experience in design, research, and manufacturing; eight years as experimental test pilot; eighteen years' flying experience. Desires position with company offering postwar future combining engineering and flying. Past employment includes several years as consulting engineer and chief engineer with large company. No objection to traveling. Address inquiries to Box 307, Institute of the Aeronautical Sciences.

Airline Engineer—Graduate Aeronautical Engineer, B. of A.E. with major in Air Transport. Two years' extensive practical experience with major air line as maintenance and operations engineer. Thoroughly familiar with problems relating to design, performance, and economic studies of present and postwar aircraft. Desires change but wishes to remain in air-line industry and continue with same type research and development. Address inquiries to Box 306, Institute of the Aeronautical Sciences.

Sales and Service Engineering Executive, fifteen years' experience in airplane, engine and accessory design, service and sales, air-line maintenance engineering. Seeking position offering executive responsibilities organizing and directing sales and service activities or air-line maintenance engineering organization, either in this country or Latin America. Long residence in Latin America. Speak both Spanish and Portuguese. Will consider major oil company aviation department. Excellent references. Available for immediate employment. W.M.C. requirements complied with. Address inquiries to Box 305, Institute of the Aeronautical Sciences.

Engineer—B.S.Ae.E. Eight years' varied aircraft experience, project engineer, design group leader, structural design and stress analysis. Interested in essential position in Los Angeles area. Release available. Address inquiries to Box 303, Institute of the Aeronautical Sciences.

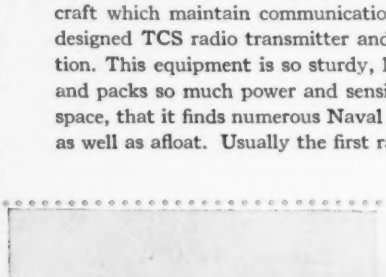
Engineer—Visualizer. Has broad and varied experience in the application of industrial visual aids (graphic illustrations) to employee indoctrination, production, plant layout, tool design, methods, cost analysis, sales, and service manuals. Developed methods to prepare such drawings economically. Desires additional work from medium size company for own office. Address inquiries to Box 302, Institute of the Aeronautical Sciences.

P-T BOAT*

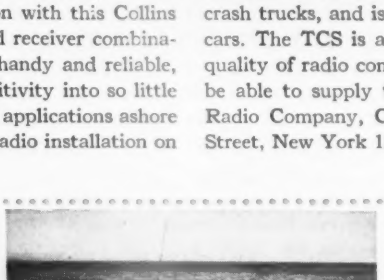
Collins Radio Equipped

HERE ARE A FEW of many types of the Navy's small craft which maintain communication with this Collins designed TCS radio transmitter and receiver combination. This equipment is so sturdy, handy and reliable, and packs so much power and sensitivity into so little space, that it finds numerous Naval applications ashore as well as afloat. Usually the first radio installation on the beach-head, it is also standard on fire, rescue and crash trucks, and is often used on jeeps and command cars. The TCS is another example of the variety and quality of radio communication equipment Collins will be able to supply to industry after the war. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

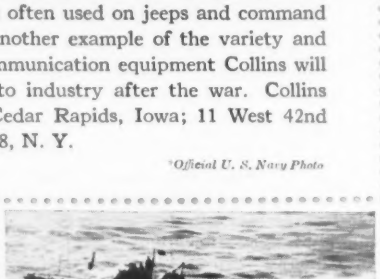
*Official U. S. Navy Photo



BOMB TARGET BOAT*



LVT-4 LANDING VEHICLE TRACK*



AIRCRAFT RESCUE BOAT*

ARMY E NAVY IN RADIO COMMUNICATIONS, IT'S . . .

COLLINS

Industrial Designer—Stylist. Varied experience in product and interior design. Recently completed redesign of series of aircraft-engine test equipment. Desires additional clients for aircraft accessories styling or small plane interior styling. Address inquiries to Box 301, Institute of the Aeronautical Sciences.

Works Manager or Executive Engineer: College education; 39 years of age; married and have family. Broad experience in Industrial Engineering; Management; Production and Engineering. Proved performance in capacities of Works Manager; Plant Manager; Executive Engineer; Plant Superintendent; Industrial Engineer and Experimental Research Manager. Nine years aeronautical; seven years steel fabrication (all phases); and three years' heavy construction experience. Extensive Army and Navy contacts. Now in East. Will consider any location including foreign. Statement of availability and references will be furnished. Address inquiries to Box 300, Institute of the Aeronautical Sciences.

Design and Development Engineer—Eight years' experience in aircraft-engine design and development as analyst, designer, chief design analyst, and project engineer. Desires work on aircraft gas turbine and reaction propulsion program. Ph.D. in mathematical physics, 1936. Release available. Address inquiries to Box 299, Institute of the Aeronautical Sciences.

Helicopter Engineer (B.S. in Aero. Engineering) 5 years' experience in helicopter theory, design, and construction; has just completed successful helicopter for small company; did entire design, stress, weights, and aerodynamics. Desires position in supervisory design capacity in reliable company. Address inquiries to Box 298, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Consultant—Seventeen years in the aviation industry on military and commercial airplanes including development, design, administration and direction of engineering groups, company representative at Service procurement centers and engineering flight test experience. Desires a permanent and responsible position in engineering or engineering sales or as a technical representative in the aviation industry or allied field. Address inquiries to Box 294, Institute of the Aeronautical Sciences.

Chief Inspector—At two airframe manufacturers (prime contractors). Ten years' inspection experience with leading aircraft companies and C.A.A. Can comply with War Manpower Commission Regulations. Draft exempt. Available latter part of April. Address inquiries to Box 293, Institute of the Aeronautical Sciences.

Production Executive—Mechanical engineer with five years' administrative experience in all phases of aircraft construction including line assembly methods, Tool and Jig design and one year as Director of experimental. Served ten years as Works Manager of large plant fabricating precision metal parts for automatic actuating mechanisms. Thoroughly familiar with modern precision machine shop practice serving eight years as Plant Manager. Manufacturing experience totals 26 years. Automotive background. Enjoy a wide acquaintance among subcontractors in central and eastern area. Will travel. Address inquiries to Box 292, Institute of the Aeronautical Sciences.

Retired Marine Corps Officer—Thoroughly familiar with Carrier Type Aircraft and Navy Procedure, desires position, preferably as Field Service Manager, with Manufacturer of Naval Aircraft or allied equipment. More than 17 years' experience, best of references, proven record. Address inquiries to Box 290, Institute of the Aeronautical Sciences.

Engineer—Registered university graduate and professional aeronautical engineer. Ten years' experience in the aviation industry including airplane design, stress analysis and structures, aerodynamics and Director of sales, engineering and production in aircraft accessories field. Desires to make permanent connection as executive, design engineer, sales engineer, or technical representative in the aviation industry, or as an aviation manager or technical adviser in nonaviation industry. W.M.C. will be complied with. Address inquiries to Box 289, Institute of the Aeronautical Sciences.

Research—Economic Planning and reporting work desired. Good background in aviation manufacturing industry, B.S. Degree in Economics, now working toward Masters Degree in Economics. Connection desired with aviation manufacturer or transport line. Address inquiries to Box 286, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Responsible for the development of several successful aircraft, desires additional design or supervision work under contract. Address inquiries to Box 273, Institute of the Aeronautical Sciences.

Aeronautical Engineer—A graduate engineer with 14 years' continuous aircraft experience in research, development, and design of military and commercial airplanes desires connection offering immediate and postwar opportunities. Past experience included positions as Project Engineer, Chief Project Engineer, Assistant Chief Engineer, and Chief Engineer. Has demonstrated ability to organize and supervise engineering departments and to maintain direct responsibility for important experimental and production airplane design projects. Prefers position where technical knowledge and the attainment of close Engineering-Production cooperation is required. Address inquiries to Box 272, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—B.S. and M.S.E., Commercial Pilot, three years' experience in flight-test work involving handling characteristics of a variety of airplanes. Can get full release for position that involves flying. Would prefer position where engineering and flying can both be used. Address inquiries to Box 270, Institute of the Aeronautical Sciences.

Inspector and Quality Control Engineer—Five years' experience with high-altitude fighter planes, desires employment with an air line. B.S. degree; speaks three foreign languages fluently; any location. Address inquiries to Box 237, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer—Honorably discharged Army Air Forces, formerly executive Chief Engineer, Administrator, Designer desires new connections or additional consultant work. Preliminary aircraft design and jet propulsion specialist. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

Landing-Gear Control Systems

(*Continued from page 19*)

The writer desires to express appreciation to the following, for helpful comments and suggestions: R. H. Kaufmann, General Electric Company; Major G. J. Rodenberg, Aircraft Laboratory, Wright Field; Lt. D. L. Moran and C. C. Colombo, Equipment Laboratory, Wright Field.

REFERENCE

[1] Kaufmann, R. H., *Electric-Circuit Fault-Protective Principles as Applied to DC Aircraft Systems*, Electrical Engineering, Vol. 63, No. 6, Supplement, pp. 333–344 (Transactions), June, 1944.

One design ON LARGE OR SMALL PLANES gives maximum braking effectiveness

The inherent soundness of the *NEW BENDIX* disc brake design is demonstrated by its ability to meet the braking requirements of all types of planes.

The same principles of construction are applied to brakes ranging from 9 in. to 31 in. in diameter and the same outstanding braking results are obtained regardless of the size or type of plane.

In this new Bendix disc brake, heat absorbing elements called rotors turn with the wheel by means of keys fastened to the wheel itself. These rotors are made in sections rather than in a continuous ring which results in far greater capacity for heat absorption, eliminating fading or warping of either rotating or fixed members.

Also contributing to all around efficiency is the fact that this new design effects considerable weight reduction in wheel and brake assembly.

Thus low hydraulic displacement and greater heat absorbing capacity combine to produce maximum braking effectiveness.

Bendix

PRODUCTS DIVISION

BENDIX AVIATION CORPORATION
SOUTH BEND 20, INDIANA

Bendix* Landing Gear • Bendix Pneudraulic* Shock Struts • Bendix Airplane Wheels • Airplane Brakes • Hydraulic Master Cylinders and Power-Brake Valves make up the list of Bendix Landing Gear Equipment.

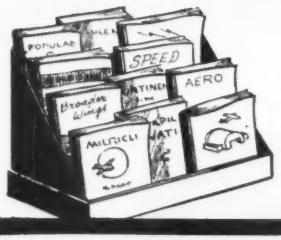
*TRADE MARK

***Design Features*—Fixed discs are faced with friction lining; lining is segmented in such a way as to scavenge lining dust and provide air circulation. Eliminates fading and gives greater braking force with less contact pressure.**

Rotating members, keyed to the wheels, provide large heat-absorbing capacity.

Rotors are made in segments instead of a continuous ring; this allows for heat expansion without warping or cracking.

PRODUCT OF Bendix AVIATION CORPORATION



Periodicals

Accessories and Equipment

Design of Hydraulic Systems. Part IV. Howard Field, Jr. This is the fourth article of a series discussing various phases of hydraulic-system design. The design, characteristics, uses, and construction of selector and relief valves are analyzed. Valves are classified as to type. Sketches illustrate design and operating features. Problems connected with the selection of materials and the prevention of internal leakage are discussed. *Product Engineering*, April, 1945, pages 265–269, 13 illus.

Aerodynamics

Stability of Tailless Aeroplanes. A. R. Weyl. This is one of a series of articles dealing with tailless airplanes. The earlier articles reviewed the history of those types of aircraft. The current article takes up the aerodynamic aspects and begins with the special problems of stability arising from the peculiarities of tailless airplanes. A discussion of longitudinal stability opens with an elementary outline of the subject in general as applicable to all types of airplanes and the writer quotes various American and British writers with regard to longitudinal stability requirements. He discusses static and dynamic longitudinal stability, the qualities of airfoil sections with regard to stability, and the peculiarities of the aerodynamic center. Other aspects of the discussion are damping in pitch, various kinds of oscillations, and the static-stability factor. Results of actual flying experiences are reviewed. *Aircraft Engineering*, March, 1945, pages 73–81, 9 illus.

Principles of Rotary Wing Aircraft. Part I. Alexander Klemin. The first part of a serial article presents the theory of hovering in an introductory fashion, with some definitions and symbols, explaining such terms as rotor disc area, disc loading, induced velocity, momentum theory, figure of merit, and the equations for thrust, drag losses, power losses, thrust-power ratio, and other factors. After these initial conceptions of the rotor as an idealized disc working in a perfect fluid, the writer expands the discussion to the individual blades, which are regarded as airfoils, and defines other terms and equations used for calculating the performance of the rotor theoretically. He then indicates the reasons for discrepancies between theoretic calculations and the results of hovering tests, and gives nine examples of the accurate computation of certain helicopter specifications and performance data. *Aero Digest*, April 1, 1945, pages 80–83, 171, 173, 175, 4 illus.

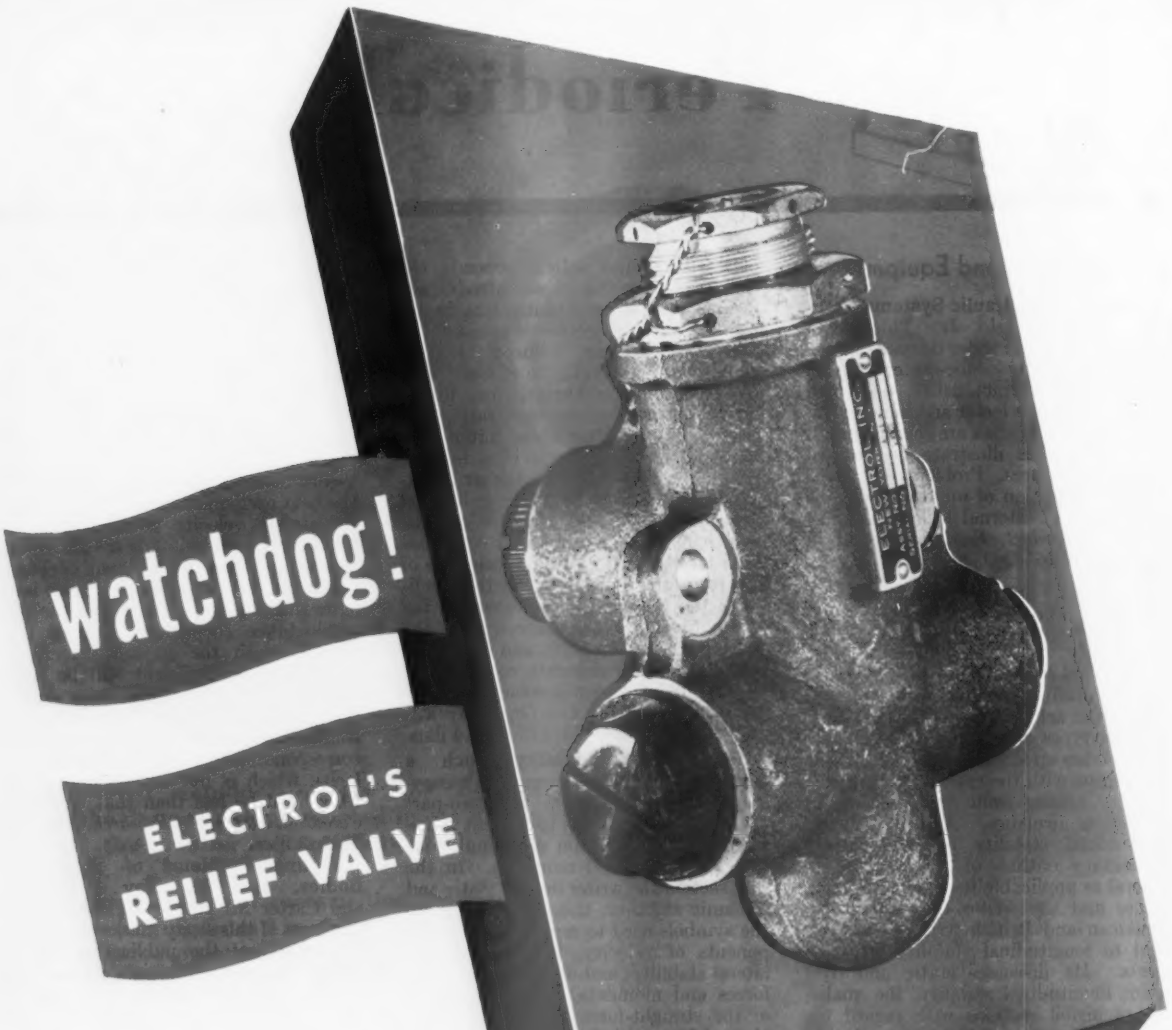
Is Airplane Stability Such a Mystery? Part I. George H. Tweney. The basic intention in this two-part analysis of stability is to present a discussion and derivation of formulas for stability forces and moments. In the first section the writer defines static and dynamic stability, the axes of motion, the symbols used to represent the components of velocity, longitudinal and lateral stability, and other aerodynamic forces and moments The calculation of the straight-force derivatives is explained first, with formulas followed by a study of the moment derivatives, the most important of which are those which enter into the longitudinal-stability equation. Other relationships for which the calculations are given are the pitching moment, the moment of the tail around the center of gravity, and the cross-wind force. *Aviation*, April, 1945, pages 145–147, 248, 251, 5 illus.

Flow of Gas Through a Tube of Constant Cross-Section with Heat Exchange Through the Tube Walls. B. Szczeniowski. Theoretic investigations indicate that the influence of the exchange of heat between a gas flowing through a tube and the outside atmosphere in the gas stream is marked in the case of large stream velocities, approximately the velocity of sound. The theory also permits it to be stated that the heat exchange is possible only when the stream velocity is maintained beyond certain limits. For stream velocities within these limits, heat exchange is not possible. The investigator indicates that the present view that the heat conductance coefficient increases continually with the stream velocity is wrong. This coefficient will be equal to zero when the stream velocity reaches the velocity of sound. This means that it will reach a certain maximum value corresponding to a value of stream velocity which is not exactly known but which will be less than that of sound. *Canadian Journal of Research*, January, 1945, 3 illus.

Lofting Problems of Streamline Bodies. Part 21. Roy A. Liming and Carter M. Hartley. The twenty-first part of this study marks the second resumption of the publication of the series. It appeared in eight consecutive numbers of *Aero Digest* beginning in December, 1941, and in twelve installments throughout 1943. The current article contrasts the mathematical methods with the so-called "trial and error" process of determining the "fairness" of a curve by the eye, aided by the "spline and duck." The writers review the basic principles and factors involved in conic lofting which determine the exact nature of the transverse section in a given fuselage station, and then pro-

INDEX

Accessories and Equipment.... 55
Aerodynamics..... 55
Air Power..... 57
Air Transport..... 57
Airplane Descriptions..... 59
Airports and Airfields..... 60
Armament..... 63
Avigation..... 63
Bearings..... 65
Business and Finance..... 65
Civil Aviation..... 65
Design..... 65
Education..... 67
Electrical Equipment..... 67
Engines..... 67
Flight Operations..... 68
Flight Technique..... 68
Flight Testing..... 68
History..... 68
Inspection..... 68
Instruments..... 68
Lubricants..... 71
Maintenance..... 71
Materials..... 71
Medicine..... 73
Metallurgy..... 73
Military Aviation..... 73
Paints and Coatings..... 73
Plants..... 75
Plastics and Plywood..... 75
Private Flying..... 75
Production..... 79
Propellers..... 83
Radio..... 85
Reaction Propulsion..... 85
Research..... 85
Rotating Wing Aircraft..... 85
Stress Analysis..... 85
Testing..... 87
Testing Equipment..... 87
Tools and Equipment..... 87
Training..... 87
Warfare..... 89
Weight Control..... 89
Welding..... 89



Sudden increases in Hydraulic System pressure cause the Relief Valve to function and by-pass the excessive pressures, thereby preventing damage to the system. Electrol's Relief Valve operates efficiently for pressures within a range of fractional to excesses of 3,000 lbs. per square inch.

The unfailing performance of this light yet dependable watchdog to Hydraulic Systems is a matter of record. It has been performing faithfully on America's fighting aircraft during the entire war period.

Consult Electrol for detailed information on this and other important units for Hydraulic Systems, as well as special designs for your particular needs.

ELECTROL
HYDRAULICS
ELECTROL INC. KINGSTON, NEW YORK

ceed to an explanation of the "projective discriminant" as a conic control factor. The term is defined as referring to a ratio that enables the engineer to discriminate with respect to the nature of the conic section and for which the geometric basis is projective in character. A tabulation is given to show the identifying characteristics of the conics from the standpoint of projective-analytic geometry, as well as from the more familiar metric point of view. *Aero Digest*, April 1, 1945, pages 74–78, 9 illus.

Air Power

How the Red Air Force Fights. Curtis Fuller. An analysis of Soviet concepts of air power and the methods employed by the Russians in using their air forces. It is shown that, in contrast to British and American emphasis on strategic aviation, the Russians stress tactical operations. Descriptive data on various Russian fighter planes are included in development of the theme that the Soviets design their aircraft and make their combat-aviation plans mainly for support of ground troops. *Flying*, May, 1945, pages 21–23, 132, 134, 137, 5 illus.

Preserving American Air Power. Lynn L. Bollinger, Tom Lilley, and Albert E. Lombard, Jr. Consideration is given to the problems and difficulties involved in preserving America's future air power. The following seven key questions are set forth and discussed in detail: (1) What size peacetime air forces will meet our military needs and still be economically feasible? (2) What government policies should be adopted to stimulate a healthy rate of technical progress? (3) How can a properly balanced and rapidly expansible nucleus of productive capacity be maintained in peacetime? (4) To what extent should plans for any future wartime expansion rely upon the peacetime aircraft companies, and to what extent should such expansion involve conversion of automobile and other nonaircraft industries? (5) What role should civil aviation and exports play in supporting our peacetime military aircraft industry? (6) What plans for transition from the present war to peace should be made in advance to assure the preservation of an industry adequate for tomorrow's tasks? (7) How should the air forces and government civil agencies concerned with aviation be most effectively organized? *Harvard Business Review*, Spring, 1945, pages 372–392.

Air Transport

All-Weather Transport Operations. Lt. Col. E. A. Cutrell. Consideration is given to what is required to make all-weather air transport operations feasible and safe. It is stated that the way to determine these requirements is by actual flying in every kind of weather. A program is recommended which indicates a 90 per cent reduction in cancellations. *Air Transport*, April, 1945, pages 44, 46, 49, 50, 53, 55, 4 illus.

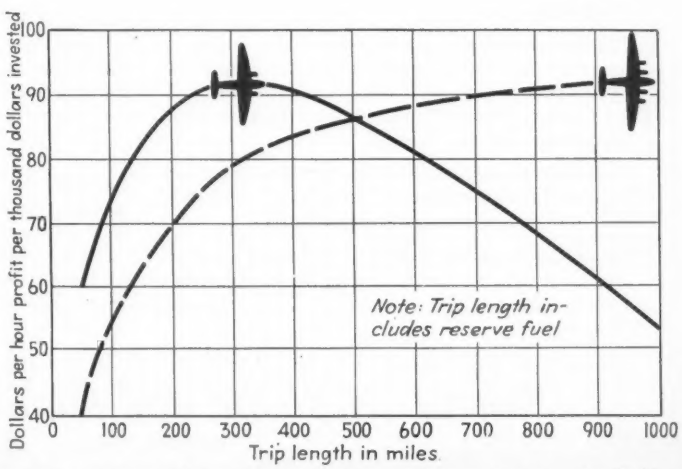
As the Crow Flies. Part II. Leighton Collins. The second part of an article proposing a national air-taxi system that could offer a one-way charter service. This installment investigates operational problems, potential business volume and income, costs, dispatching details, and reciprocity advantages of the suggested plan. As outlined, the system would function through an association of fixed-base operators rather than through the services of a company organized for the purpose. *Air Facts*, May, 1945, pages 17–20, 22–24, 26, 27.

"In the Public's Best Interest." W. A. Patterson. The opinions of the President of United Air Lines, Inc., are expressed in this fifth installment of a symposium on whether surface carriers should be permitted to participate in postwar air transportation. Arguments are offered to support the writer's contention that integration of air and surface transportation would not be in the best public interest at the present time. However, his beliefs are qualified by the point of view that integration should not be eliminated from future consideration by the adoption of definite legislation barring surface carriers from conducting air operations. *Aero Digest*, April 1, 1945, pages 54, 55, 128, 130, 1 illus.

Why More Than Two Engines? Charles H. Hurcamp. In this examination of the power-distribution requirements for transport aircraft, the economic and safety values of two-engined and four-engined types for average domestic air-line operations are compared. While the writer (head of the Design Department of Curtiss-Wright Corporation's St. Louis plant) concedes that for long-range and over-water air routes the four-engined airplane is superior, he offers proof in support of his contention that, for an intermediate size airplane intended for air-line operation in full compliance with existing C.A.A. regulations and designed for a given load capacity, a two-engined airplane is equal in safety to a four-engined airplane and superior to it in performance, operational economy, and profit potentialities for short and intermediate-length trips. A detailed analysis is based on the Curtiss Commando and a similar airplane equipped with four engines, operating under uniform specifications, to make the comparison as fair as possible. Charts and tables supplement the analytic data and a bibliography is included with the article. *Aviation*, April, 1945, pages 124–128, 6 illus.

Are Short-Haul Airlines Practical? Richard H. Rush. The writer attempts to develop principles for the determination of whether a particular short-haul line is practical and justifiable from the point of view of what the public is reasonably entitled to, taking into consideration any possible effects, either favorable or unfavorable, on the trunklines. He suggests a method for computing traffic and costs on a short-haul line. Based on actual average operating expenses of 10- to 14-passenger transports compared with 21-passenger DC-3's, he indicates the probability of higher seat-mile costs for most feeders. *Air Transport*, April, 1945, pages 22–27, 8 illus.

Measuring That Feederline Market. Part I. James G. Ray. First of four articles dealing with various phases of feeder air-line operations. In article number one, specific methods are detailed for determining the probable amounts of traffic which would be generated by a feeder air-line system in a given area. The forecasting of passenger, mail, and express volumes is considered. *Aviation*, April, 1945, pages 106–109.



A comparison of the possible gross profits of two- and four-engined aircraft in flights varying from 50 to 1,000 miles.

Many Armed Servant

The many arms of the FEDERAL organization are the arms of a versatile servant . . . making war goods now and preparing for the new and greater demands of a world at peace.

* * *

For example, FEDERAL INSTRUMENT LANDING AND RADIO RANGE equipment is pioneering new concepts of faster, safer air travel.

FEDERAL'S MEGATHERM dielectric and heat induction units are revolutionizing production processes in the plastics, metal, food, plywood, textile and other industries.

FEDERAL always *has* made better tubes. Today, as the result of continuous scientific development, FEDERAL'S TRANSMITTING, RECTIFYING AND INDUSTRIAL POWER TUBES are proving even more dependable and long lasting.

To fill a vital war need, FEDERAL developed INTELIN ULTRA HIGH FREQUENCY TRANSMISSION LINE — now is the world's largest manufacturer.

FEDERAL'S MARINE RADIO EQUIPMENT, first in serving America's merchant fleet, includes DIRECTION FINDERS, AUTO ALARMS, packaged TRANSMITTING AND RECEIVING UNITS and LIFEBOAT TRANSMITTERS.

Back of every FEDERAL TRANSMITTER are years of engineering and manufacturing experience which assure the ability to produce any type or power of communications equipment from walkie-talkie to 200 K.W. transmitters.

QUARTZ CRYSTALS, precision cut and mass produced at FEDERAL, are performing many secret military jobs.

SELENIUM RECTIFIERS, introduced by FEDERAL, are accepted as standard for converting alternating to direct current. Power equipment and battery chargers, powered by FEDERAL SELENIUM RECTIFIERS, are known for long life, high efficiency and low cost.

* * *

Yes, FEDERAL'S many arms make many things — all to one high standard. Here some of the world's keenest scientific minds combine their talents with three decades of FEDERAL leadership for developing and producing better communications and industrial electronic equipment.

Federal Telephone and Radio Corporation

Newark 1, N. J.

AN IT&T ASSOCIATE

The Future's Stake in Aviation. Charles Froesch. An analysis of some of the potentialities and future trends of air transport, by the Chief Engineer of Eastern Air Lines, Inc. Outlining the progress that will take place and the problems that will have to be solved in efficiently utilizing the speed of the airplane in each stage, he predicts that air transport will pass through three successive periods of postwar development. Phases of future development which are discussed include factors governing speed and economical operation of the airplane; probable size of future aircraft; uses of the helicopter; facilities and airports. As a basis for future projection, three charts illustrate the growth of air mail, air express, and air transportation of passengers since 1930. *Aero Digest*, April 15, 1945, pages 55–57, 200, 4 illus.

South African Airways. The history of South African Airways since 1934 is briefly reviewed, its operations outlined, and some of its plans for the future noted. The information related includes references to the company's aircraft and other equipment; routes and schedules; maintenance system and facilities; and personnel-training program. An account of a typical journey on this air line serves to illustrate some of the company's services and facilities. Advantages of air travel in South Africa are remarked. *The Aeroplane*, March 16, 1945, pages 314–316, 6 illus.

Block-to-Block Speed as a Factor in Scheduled Airline Operation. George H. Tweney. The factors that govern the time consumed by a commercial airplane in moving from one stop to another on a scheduled flight are examined. This is called the scheduled speed or block-to-block speed, or the "speed made good," and the determining factors are listed as (1) straightaway cruising speed of the airplane; (2) wind speed and wind direction; (3) the altitude of the flight; (4) the type of engine used, i.e., whether supercharged or not; (5) maneuvering time. The maneuvering time is broken down into ten elements that account for the time elapsing between the start from the apron until the plane has attained cruising speed on the course, and the similar time consumed in coming to a stop at the next station, including fueling and minor service and stopover time. A formula is derived for calculating low-altitude flight over relatively short routes, from which curves are plotted to show effects of various maneuvering times, head-wind conditions, and the type of airplane used over various distances.

Next a case is considered in which the route is long enough to permit the airplane to gain altitude for a portion of the route and fly at high levels for comparatively long periods. Equations are developed for computing the time of each portion of the flight, making allowance for variations in engine power at different altitudes and for varying air densities. An expression is worked out for calculating the "speed made good" of any type of airplane over long distances at high altitudes, using known factors, and it is suggested that similar calculations and charts can be made for different altitudes and different airplanes for purposes of comparison. *Aero Digest*, April 15, 1945, pages 80, 81, 183, 186, 5 illus.

Relationship of the Airport to the Post Office. Oliver L. Parks. It is stated that little thought has been given to facilities that will enable trunk and feeder air lines to carry all first class mail by air. The need for airports at the main post offices in all large metropolitan areas is suggested. The specifications for such airports are discussed. *Air Transportation*, March, 1945, pages 16, 24.

Everybody Is Talking About Postwar Air Transportation Policy. The question of whether the United States will favor a competitive or monopolistic system for American air lines engaging in postwar international air transport is discussed. Following a brief review of the governmental policies pursued prior to and during the war, the courses advocated by several different factions are noted. These are the Civil Aeronautics Board, the War Department, the Navy Department, Congress, Pan American Airways, and domestic air carriers. The attitude of air lines owned in other parts of the world is examined also. In conclusion it is stated that, although the present trend is toward regulated monopoly, there is strong opposition within Congress which may result in legislation that will reverse the situation. *U. S. Air Services*, April, 1945, pages 14–17, 1 illus.

Misr Airlines. A summary of the history and operations of the Egyptian company, Misr Airlines, and its parent company, Misr Airwork, S.A.E. Data are included on the companies' capitalization, directors, organization, services, schedules, routes, and equipment. Information is also given relative to flying schools conducted by Misr Airwork. Air services currently operated are listed and the air-line's traffic statistics are tabulated for the years 1935 to 1944. *The Aeroplane*, March 30, 1945, page 365, 2 illus.

The Flight Radio Officer-Navigator. Floyd A. Hermanson. This article describes the functions of the flight radio officer and the value of his work in international airways operations. Explaining the applications of radio aids to navigation, it also demonstrates the advisability of having the navigational duties on a transport airplane delegated to the radio operator instead of the copilot or other air-crew member, or as an alternative to teaching nontechnical navigators the use of highly technical radio navigational equipment. A brief review of the history of the flight radio operator's work is included. *Aero Digest*, April 15, 1945, pages 60, 61, 190, 2 illus.

Tons—Not Pounds! Charles J. Roggi. The writer believes that air transport is about to enter a period of intense economic competition with the railroads and the trucking industry. It is stated that the great future of the air-transportation industry lies in the field of air cargo. The importance of specialization in air-cargo handling is emphasized. It is stated that greater progress and more rapid handling of cargo will be realized when the subject is approached as one more closely related to the basic design of the airplane rather than to operating techniques and practices. *Air Transportation*, April, 1945, pages 7, 8, 10, 11, 1 illus.

Airplane Descriptions

Jap Aircraft. A compilation of data on Japanese aircraft is listed in two tables—one for Japanese military airplanes, the other for Japanese naval airplanes. The code name, manufacturer, span, speed, range, engine manufacturer, and take-off horsepower are listed for planes in fighter, bomber-reconnaissance, and transport classifications. *Flying*, May, 1945, page 62; "Copycat Killers," *Air News*, April, 1945, pages 16, 17, 70, 6 illus.; "New Jap Warplanes for Home Defense," *Skyways*, May, 1945, pages 24–27, 68, 76, 3 illus.; "The Jap Air Force," Roel I. Wolfson, *Flying Age*, May, 1945, pages 13–25, 68–72, 34 illus.; "Operational Japs," *Flight*, March 15, 1945, pages 282–284, 6 illus.

The Miles M-56 Air Liner. A summary of the characteristics, accommodations, specifications, and estimated performance of a 24-seat air liner designed by Miles Aircraft Ltd. Powered by two Rolls-Royce Merlin engines, the M-56 is reported to be a high-wing, all-metal monoplane with twin rudders and tricycle undercarriage. The combination of an adequately high-cruising speed of 200 m.p.h. with exceptionally low wing and power-loading values is indicated as the notable feature of its design. Economical cruising speed is based on only 33 per cent of the total take-off power of the two engines. Alternate versions of the M-56 are intended to use either two Bristol Perseus or four Armstrong Siddeley engines. *The Aeroplane*, March 23, 1945, pages 342, 343, 3 illus.

Roadable Plane. Some brief notes describe the "Airmobile," a roadable plane invented by Rene Charette, of Canada. As reported, the feature that distinguishes this aircraft is a wing control that eliminates the elevators. It also has a new-type trim tab, a rear-view window and a flap that increases lift and slows down forward speed, while permitting a more pronounced angle of descent with complete control. The maximum speed of this all-wood aircraft is 90 m.p.h. in the air and 40 m.p.h. on the ground, with a landing speed of 20 m.p.h. It is estimated that the price of the Airmobile will range from $900 to $1,500. *Canadian Aviation*, April, 1945, page 71, 2 illus.

Finnish Pilot Finds Soviet Planes Good as Any Warcraft in World. This description of some recent Russian warplanes is based on an article by a lieutenant in the Finnish Air Force, which appeared in the Swedish aviation publication *Flyg*. Particular reference is made to the new LA-7 fighter, which is stated to be faster and more maneuverable than the FW 190 and the Me 109. It is said to be powered with a 2,000-hp. engine. Some information is also furnished about other Soviet fighters and bombers, including the TU-2 and the IL-4. *American Aviation*, April 15, 1945, page 34, 4 illus.

The S.10 and the S.O.90. With more emphasis on the former, some brief descriptive details are given about the S.10, a French training plane, and the S.O.90, a French transport plane. The information is supplemented by observations regarding the difficulties of manufacturing aircraft under recent and present conditions in France. *The Aeroplane*, March 2, 1945, page 251, 4 illus.

Small Feeder Aircraft. Brief particulars are given about the Avro XIX, which is stated to be the most recent development of the Anson. It is intended for commercial uses on feeder services and as an air taxi. Reference is made to the similarity between this aircraft and the Anson XII, which is used by the R.A.F. for transport and communications work. The XIX is powered by two 425-hp. Armstrong-Siddeley Cheetah engines. It has a loaded weight of 10,600 lbs. and a pay load of 1,670 lbs. The maximum speed is 190 m.p.h., the maximum cruising speed 175 m.p.h., and the range 660 miles. It can accommodate six passengers and a crew of two. The wing is of the standard Anson type. *Modern Transport*, March 10, 1945, page 7, 4 illus.

The Fairchild Cornell. Flight Lt. D. A. S. McKay. First of a series of articles dealing with the handling characteristics of various aircraft. This one surveys the specific features to be noted in piloting a Canadian-built Fairchild Cornell II used by the R.A.F. Training Command in Southern Rhodesia. It also contains details regarding the design and construction of the plane. *The Aeroplane*. March 9, 1945, pages 284, 285, 5 illus.

Four New Models Announced by Skylark. Some brief details describe a series of light planes being prepared for postwar use by Skylark Manufacturing Company. The four models are variations of a basic low-wing, twin-boom pusher design, each having different engines as well as varied seating and luggage arrangements. They are expected to sell at prices varying from $4,000 to $5,800. Performance data and specifications are listed for the contemplated four-place model. *Aviation*, April, 1945, page 176, 1 illus.

Airports and Airfields

Profits Ride in on Those Buses. William H. Rodda. Indicating how adequate bus facilities can add to the profit possibilities of airport operation, this brief article contains a few suggestions for the improvement of bus service to and from the airport through the efforts of the airport operator himself. *Aviation*, April, 1945, page 171.

Runway Construction for Very Heavy Airplanes. James C. Fuller. Problems connected with the building of Lindbergh Field's 8,500-ft. runway are related, together with the solutions derived. This runway was constructed to accommodate the heaviest airplanes now manufactured as well as even larger ones contemplated for the future. A description of the runway's design and construction is supplemented by figures showing the wheel loads it can support, data about the materials of which it is composed, and information relative to the planning, grading, filling, and paving processes involved in its building. *Southern Flight*, April, 1945, pages 46, 47, 2 illus.

The Class II Airport. Operations, facilities, methods, and financial aspects of the Municipal Airport at Scranton, Pa., are analyzed in a report on a "typical" Class II airport operation.

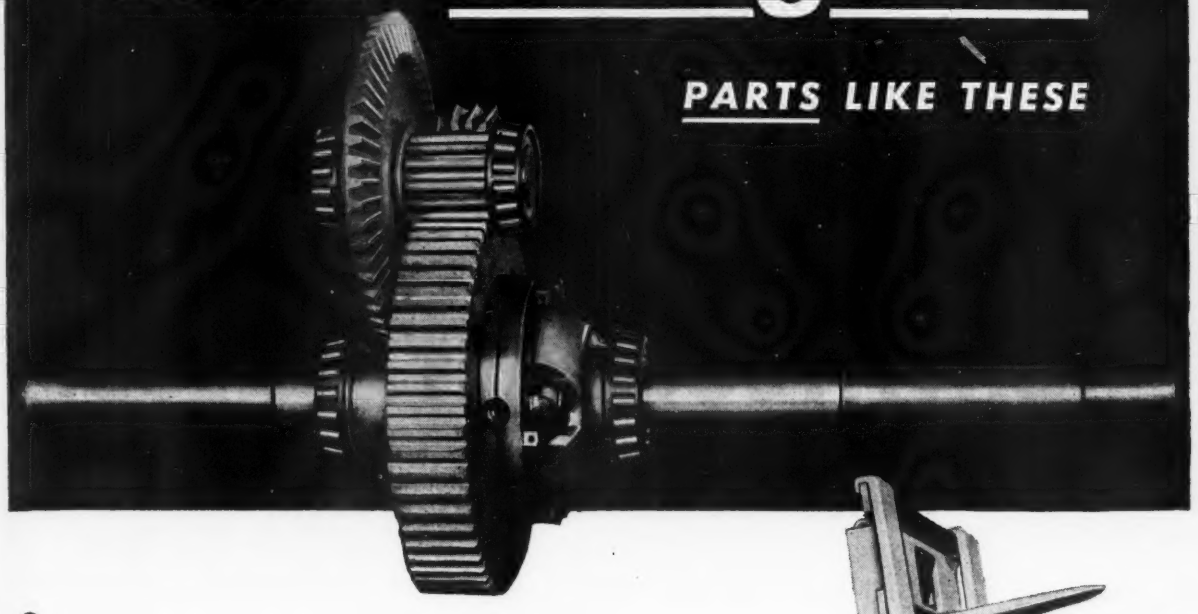
The report takes into consideration location and layout of the field; equipment; management and personnel; costs, revenues, and charges; maintenance of turf, lights, and runways; dealerships and contracts; subsidies; advertising; the history of the field;

For your postwar personal airplane reliable instruments by Autoflight will simplify your problems of global navigation. Today, precision-built Autoflight Direction Indicators (Model 2221 illustrated) are obtainable for most private planes and airliners. Autoflight builds the smallest in size and the lightest in weight Direction Indicaters manufactured anywhere.

Autoflight shows the way, having designed and produced "perceptible at a glimpse" aircraft instruments. Write for Catalog A-45 giving complete data. Address — G. M. Giannini & Co., Inc., 161 E. California Street, Pasadena 5, Calif. U. S. A.

AUTOFLIGHT

NICKEL ALLOY STEELS Strengthen PARTS LIKE THESE

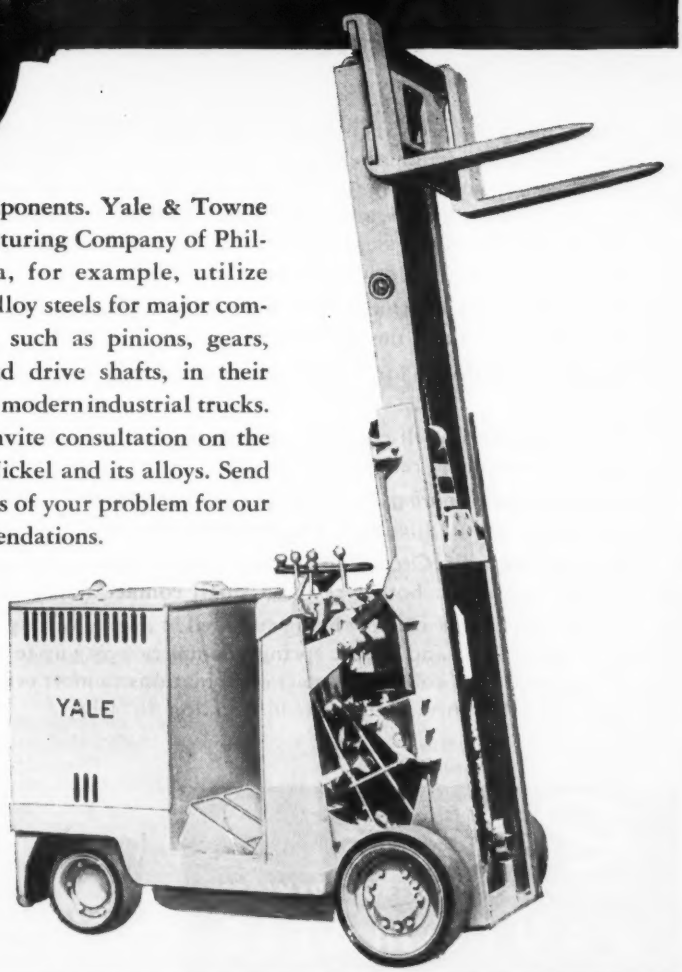


Strength of steel may be increased by additions of Nickel... without sacrificing ductility... but that's not the whole story.

Nickel additions improve toughness and promote depth hardening in heavy sections. In addition, Nickel intensifies the effect of other alloy elements.

Alloy steels fortified by Nickel have proved reliable for automotive components. Yale & Towne Manufacturing Company of Philadelphia, for example, utilize Nickel alloy steels for major components, such as pinions, gears, axles and drive shafts, in their compact modern industrial trucks.

We invite consultation on the use of Nickel and its alloys. Send us details of your problem for our recommendations.



● This modern high-lift Yale truck can deftly pick up and transport 10,000 lb. skidloads... and raise the full 5 tons through a standard range of 60 inches.

Edison Nickel-iron alkaline storage batteries provide a rugged, light-weight power source in many of these trucks. Nickel in the positive elements and Nickel plated steel parts throughout the battery contribute to its long dependable service.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

JS +++ PLUS +++
+++ PLUS +++ PL
JS +++ US +++
+++ PLUS +++ PL

LIGHT...COMPACT...PLUS!

And in Automatic's Class "S" Relay it's the "plus features" that count

It's not much of a problem to make a relay that will fit in a small space. But it's quite another matter to make a small relay that will operate unfailingly on modern aircraft, flying at high speeds, at high altitudes, and under widely varying atmospheric conditions. That's what makes these "plus features" of the Class "S" Relays so important to aviation designers—

Built-In Vibration Resistance far in excess of the requirements of the Signal Corps and the Air Forces.

Unique Spring Design for "rubbing" contact action and ease of adjustment.

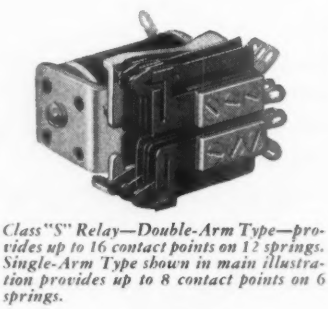
Twin Contacts with self-equalizing action, providing dual circuit paths for maximum reliability.

Long Armature Bearing and precision-formed pin pivot, to insure long working life under tough conditions.

Efficient Magnetic Circuit, combining high contact pressure with sensitivity on both large and small contact assemblies.

Class "S" Relays are now being supplied in a wide variety of types, with single and double spring pile-ups carrying up to 12 springs, and with coil and contact combinations to meet every need. For full information, write for Catalog 4071-D.

Class "S" Relay—Double-Arm Type—provides up to 16 contact points on 12 springs. Single-Arm Type shown in main illustration provides up to 8 contact points on 6 springs.



Class "S" Relays are also supplied with hermetically sealed or dust-tight enclosures and plug-in mountings, to meet exceptionally severe atmospheric conditions.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Illinois

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

and plans for the future development of the airport's business. *Airports*, April, 1945, pages 31–36, 9 illus.

Building the Small Airport. Part IV—Turfing. J. R. Yarrow. This is the fourth of a series of articles dealing with various phases of small airport construction. It is devoted to the subject of turfing. Sections discuss the costs of different types of turfing, the purpose of turfing, the planning of the turfing work, soil drainage and stabilization, the selection of grasses, fertilizers, planting periods, and maintenance. *Aviation Maintenance*, April, 1945, pages 50–53, 104, 108, 110, 112, 116, 118, 122, 124, 12 illus.

Airport Farmer. Hal Hunt. Information is given regarding the planting of airfield turf. The article has particular reference to the planting and care of turf in the open spaces outside the runways. It is noted that adequate grass or similar cover on the surfaces outside runways is necessary to control dust, blowing sand, gullying, and silting of drainage channels. Grasses and grains for airports and the mulch and fertilizers required for good turf are discussed. *Air Transport*, April, 1945, pages 69, 72, 75, 76, 8 illus.

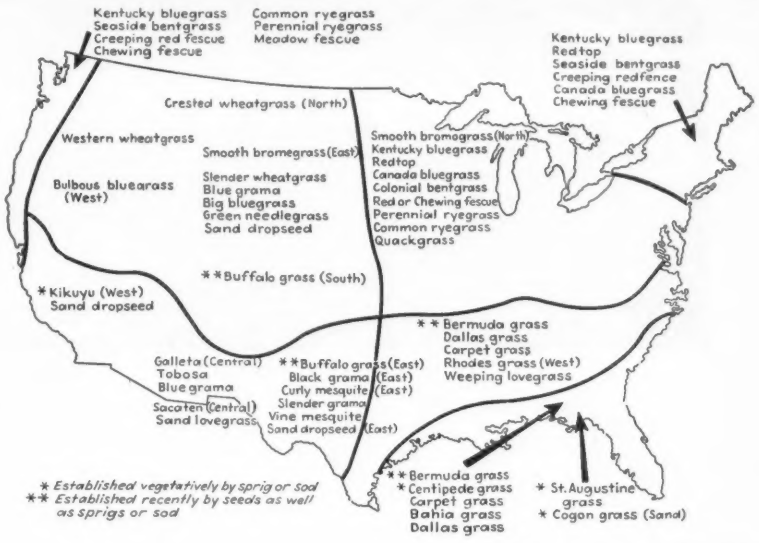
Barn Becomes Hangar. John Abiuso. As a solution to the problem of material shortages in the construction of airport buildings, an account is given of how a barn was converted into an airplane hangar. Architectural sketches supplement the constructional details. Alteration costs are listed. *Aviation*, April, 1945, pages 168–170, 5 illus.

Airport Merchandising. Dudley M. Steele. Garages, service stations, and parking are discussed in this fourth of a series of articles investigating individual revenue-producing schemes for airports. Methods employed by the Lockheed Air Terminal to make these three phases of the airport operation a profitable one are described. Figures are reported regarding the amount of business grossed with these types of service. *Southern Flight*, April, 1945, page 54.

Airpark Prescription. Joseph J. Mitchener, Jr. The first of a series of articles on airparks and their operation. Emphasis is placed on the importance of municipal cooperation in providing for the private flier and means of achieving cooperation between the operator and civic officials are suggested. Various considerations in the operation of a small municipal airport are discussed.

In the second article in the series, by Paul E. Young, the writer lists 20 simple points for a good airpark and discusses them in some detail. *National Aeronautics*, March, 1945, pages 23, 24, 1 illus.; April, 1945, pages 21, 22, 28, 1 illus.

New Horizons Opened for Aircraft Markets. John Foster, Jr. Details are given about a management contract made for the improvement and operation of Westchester County Airport in New York. It is reported that the operating company that has taken over the management of this airport is financially backed by a major oil company.



Photograph Courtesy Air Transport Magazine

Vegetative cover suitable for airfields recommended by the Construction Division of the United States Corps of Engineers.

Citing this agreement as one to be followed by other communities, the writer claims that it not only relieves taxpayers of financial burdens but will also result in great development of personal flying. *Aviation*, April, 1945, pages 114, 115, 2 illus.

Influence of Aircraft Landing Areas on American Community Life. John E. P. Morgan. The third article in a series presenting the major factors involved in the planning, design, and construction of the many types of landing facilities which will be required for postwar flying. In this article, the manager of the Personal Aircraft Council, Aeronautical Chamber of Commerce of America, Inc., discusses the influence of airports on the social and economic life of the community. Claiming that the extent to which the local landing area is adapted to the life of the neighborhood will govern the degree of the community's participation in the future of aviation, he investigates three problems in determining the landing facilities for a community, these being the location, size, and type of airport. *Aero Digest*, April 15, 1945, pages 62–65, 180, 4 illus.

Watch That Airport Lease. John H. Frederick. Advice is offered regarding points to be covered in reaching an equitable agreement on the lease of an airport which will benefit both operator and municipality. The reproduction of an actual agreement between an operator and a city and county (joint owners of an airport) serves to exemplify some of the writer's opinions about certain merits and certain inadequacies of airport leases. *Southern Flight*, April, 1945, pages 50, 52.

And Now—Waterproofed Dirt Runways. Information is given about Stabinol, a synthetic product for stabilizing soil and preventing rain from softening dirt runways. Particulars pertain to the nature of the product, methods of applying it to the runways, its effect upon runways, and the advantages to be gained through its use. *Aviation*, April, 1945, page 172, 2 illus.

Armament

How We Fight Japan with Fire. Volta Torrey. This article describes and illustrates the new gel-gas and Pyrogel incendiary bombs that are being used to raze enemy factories and shipyards. The construction of different types of these bombs, each designed for a specific job, is outlined. Diagrams show the constructional features of the bombs and an illustration shows how they are launched from aircraft. *Popular Science*, May, 1945, pages 100–109, 30 illus.

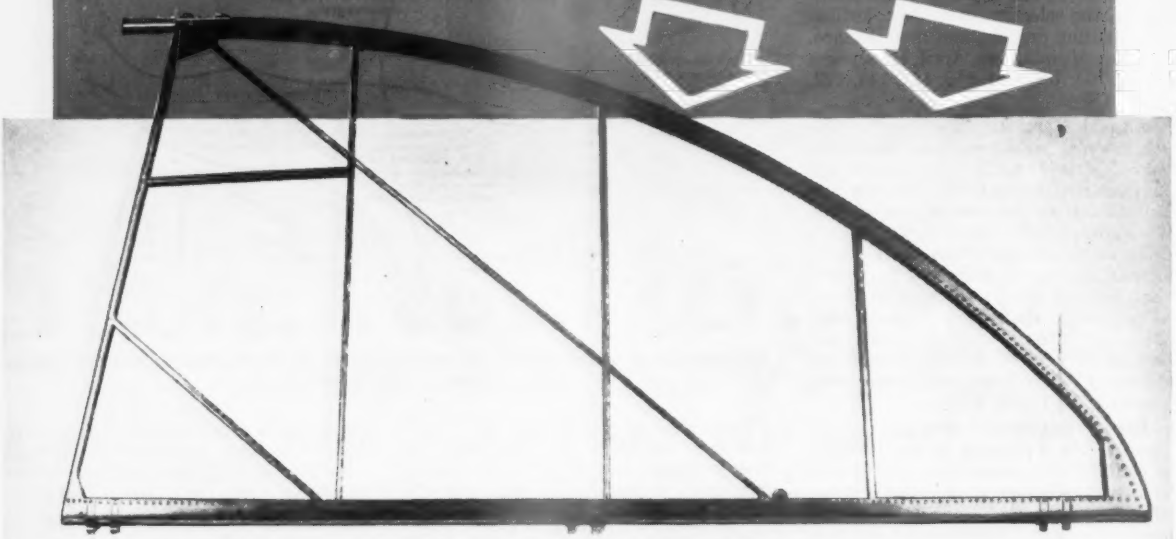
Avigation

Dual-Purpose Computer for Avigators. P. V. H. Weems. A description of the Brown-Nassau Spherical Computer for solving problems of celestial navigation and great-circle sailing. In celestial navigation this mechanical computer is used to solve for the altitude and azimuth of any heavenly body, and as an aid to star identification. In great-circle sailing, it is used to find the great-circle distance between two points, to find the initial and final courses, and to solve other problems related to the track sailed. The claim is made that the average time required for a solution of both altitude and azimuth is a little over 2 min. *Aero Digest*, April 1, 1945, page 110, 2 illus.

Graphics of World Aviation. A. J. Dilloway. The writer discusses means that will provide a graphic basis for the planning and operation of a system of air highways on a world scale. Problems connected with world air charts are surveyed. Designs are produced

Enduro saves weight

WITHOUT SACRIFICE OF STRENGTH OR SAFETY



Its high strenght-to-weight ratio and exceptional corrosion-resistance make ENDURO Stainless Steel ideally suited for many aircraft parts, including this stabilizer assembly for a popular light airplane.

Many people are familiar with the exceptional corrosion-resistant qualities of ENDURO Stainless Steel. Frequently overlooked, however, is the decided weight-saving advantage of this versatile metal—a vitally important factor in the production of aircraft parts.

Here's the story:

ENDURO possesses an extremely high strength-to-weight ratio. Because of this fact, it can be used in thinner, lighter sections without sacrifice of strength or safety. And because ENDURO does not rust or corrode, no extra thickness is required to offset weakness due to loss of metal through corrosion—no weight-adding protective coating is necessary.

But that's not all!

In both thick and thin sections. ENDURO fabricates readily by all modern methods, including spot welding. It resists oxidation at high temperatures. It retains its strength—as high as 185,000 p.s.i. in certain analyses—both at elevated and sub-zero temperatures.

Republic metallurgists will be glad to tell you more about these and other advantages of using ENDURO Stainless Steel in aircraft parts fabrication. Just call, or write directly to:

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Republic

REPUBLIC STEEL — PRODUCTION FOR VICTORY

ENDURO STAINLESS STEEL

Reg. U. S. Pat. Off.

Other Republic Products include Carbon, Alloy and "Quality" Steels—Pipe, Sheets, Strip, Plates, Bars, Wire, Pig Iron, Bolts and Nuts, Tubing

for new devices to aid in the study and protraction of world routes in the office. These consist of geared stereographic hemispheres and an auxiliary device, which are illustrated. New methods bearing on the design of navigational charts for the entire globe are proposed. Much of the discussion of navigational charts is centered around a method of overcoming the difficulties of converging meridians. *The Journal of The Royal Aeronautical Society*, March, 1945, pages 112–140, 12 illus.

Finding the Navigational Stars. Part IV. Ben C. Kenny. An explanation is given of the celestial poles and of the circumpolar stars. These stars are defined as those whose angular distances from the pole are less than the observer's latitude, and consequently they will not dip below the horizon in their apparent revolution about the pole. The writer then proceeds to identify the navigation stars contained in the Great Dipper, naming them as Mizah, the middle star in the "handle," Alioth, next to Mizah, and Dubhe, located at the edge of the Dipper's "bowl." The location of Polaris, the North Star, by means of the "pointers" of the Great Dipper, and as the end star of the handle of the Little Dipper, leads to the identification of another important star, Kochab, the brightest of the four stars forming the bowl of the Little Dipper. It is advised that the formation and positions of Polaris and Kochab be learned without reference to the Dippers or other celestial "landmarks." Between the two Dippers, the constellation Draco is found, in which the brightest star is Etamin, another navigation star. The explanation of the stars is accompanied by a night photograph and a diagram of the area of the sky lying within 42° of the north celestial pole. *Aero Digest*, April 15, 1945, pages 86, 87, 3 illus.

Bearings

Corrosion Resistant Anti-Friction Bearings. H. Habart. Reference is made to the increasing use of corrosion-resistant metals for antifriction bearings, including certain bearings for aircraft. The advantages and disadvantages of Monel alloys, stainless steels, and beryllium copper for corrosion-resistant bearings are briefly discussed. *The Iron Age*, April 19, 1945, page 70.

Business and Finance

"Level Off" Looms for Airline Profits. Raymond L. Hoadley. Although aircraft-industry profits for the year 1945 are expected to conform quite closely to those of 1944 in the opinion of the writer, he discusses why he believes they will not show a rise comparable with increasing revenues. Factors that he explains as likely to hinder the increase of profits for the coming year include delayed delivery of new equipment; fare reductions; possible cuts in mail-pay; and excess-profits tax. *Aviation*, April, 1945, pages 166, 167.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Aviation Insurance. A survey of the types of aviation insurance coverage which are currently available. Including some data about rates, information is given relative to hull insurance; public liability and property insurance; passenger liability; death and dismemberment policies for pilots; policies for passengers traveling on scheduled air lines; insurance meeting special requirements of employers to cover passengers under a group accident and employers' aviation indemnity policy; and policies insuring transoceanic air travelers against ground and flight accidents. *Air News*, April, 1945, page 62.

Civil Aviation

Agriculture Beckons the Plane. Dale Gregory. The present and future uses for airplanes in agriculture are discussed. The use of aircraft for crop dusting, seeding, and fighting forest fires is described. It is noted that airplanes have been used for herding wild horses, counting antelope and deer, feeding starving snowbound game animals, and stalking prairie wolves. *Air Transportation*, April, 1945, pages 12, 13, 28, 2 illus.

A New Kind of Pilot. Moorhen. A specialized opportunity is envisaged for the ex-service pilot in civil aviation. Claiming that pilots will undoubtedly be required by business firms for the quick transportation of salesmen, technicians, consulting engineers, etc., the writer points out that such pilots will then be in a position to learn the firm's business and combine their own job with that of firm representative. *The Aeroplane*, March 2, 1945, page 253.

Canopy Conversion for the Fairchild PT-19. An account is given of how the PT-19 can be modified for civil and commercial purposes by the addition of a canopy to enclose the open cockpit. The information pertains to the design and installation of the canopy; its price; where it can be obtained; and the effects of its installation upon the flight characteristics of the aircraft. *Southern Flight*, April, 1945, page 33, 2 illus.

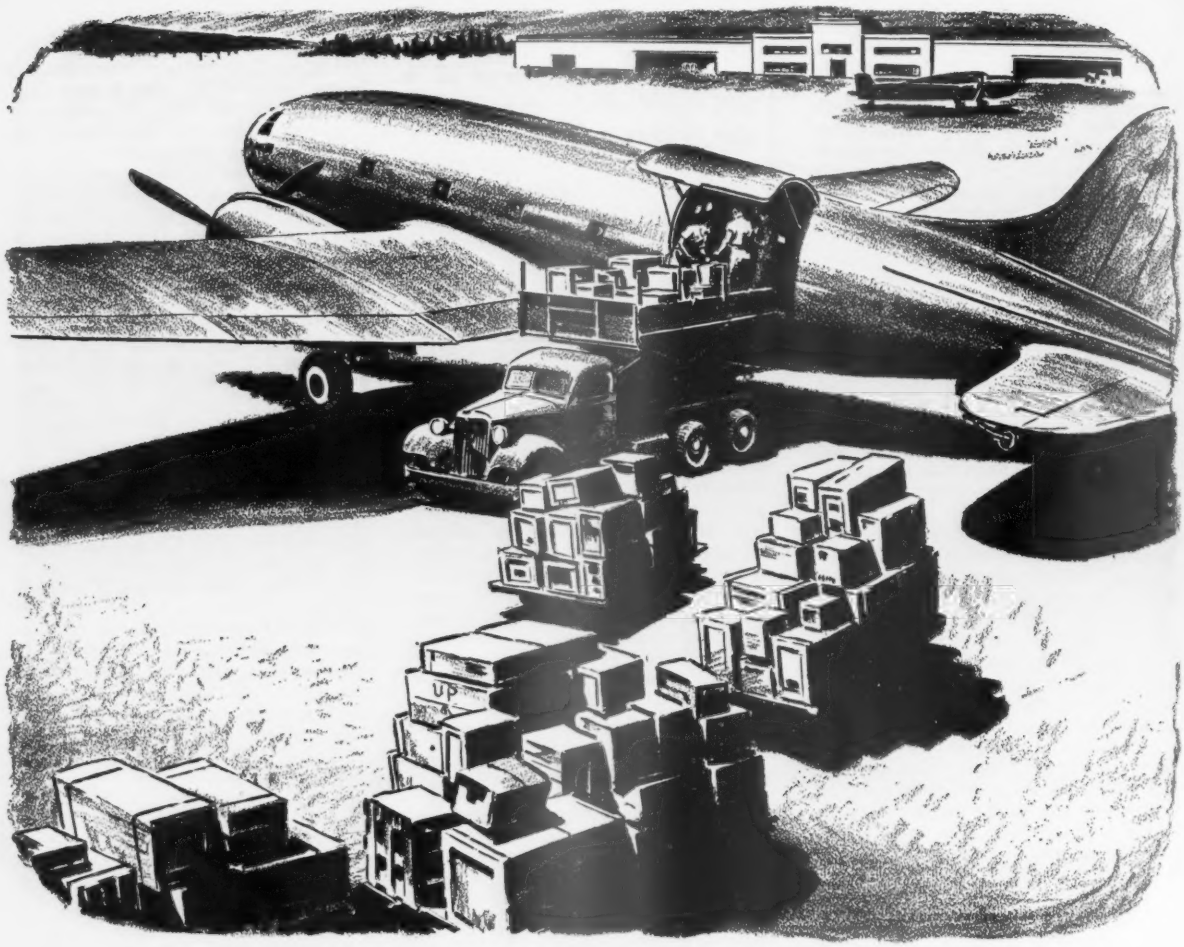
Improving the Breed. James Anthony. Four forms of air racing are examined to judge their possibilities and relative values in promoting technical aviation development and bringing prestige to the British aeronautical industry. The categories are long-distance racing (as typified by the MacRobertson Trophy); medium-distance racing (typified by the King's Cup, long course); short-circuit racing (such as pylon racing in the United States and the King's Cup, short course); and long-distance record breaking (exemplified in the article by Henshaw's flight to the Cape and back). The overall conclusion is that aims for the future should be directed toward encouraging long-distance racing and record-breaking flights. To ensure that shorter races serve a useful function, it is recommended that they be conducted under the control of the Royal Aero Club. *The Aeroplane*, March 16, 1945, page 308, 1 illus.

Design

Design Analysis of the Lockheed "Constellation." Hall Hibbard. The Vice-President and Chief Engineer of the Lockheed Aircraft Corporation analyzes the design features of the Constellation. Following a brief outline of the general specifications of this 64-passenger, four-engined transport, he discusses the construction of the various components of the plane. Consideration is given to the design of the wings, flaps, empennage, fuselage, engine nacelles, and landing gear. Other sections give particulars about the fuel system, surface controls, hydraulic system, and electrical system. Among the illustrations shown is a large cutaway view of the transport, revealing the interior details. *Industrial Aviation*, April, 1945, pages 7–10, 12–16, 18–23, 23 illus.; "Control Systems and Mechanisms in the Constellation," *Product Engineering*, April, 1945, pages 226–234, 11 illus.

Supermarine Seafire. Wilfred E. Goff. This review of production methods and equipment employed in the manufacture of the naval, folding-wing version of the Spitfire also contains details about the design features of the plane. In the design and production analyses, attention is called particularly to the wing joints, spar booms, spars, leading edge of the wing, wing assembly, main assembly fixture, and assembly operations in the main fixture. A general arrangement drawing of the Seafire, sectional drawings of its components, and photographs of the equipment used for its manufacture supplement the text. *Aircraft Production*, April, 1945, pages 159–170, 39 illus.

Flying Automobiles. Lt. H. Piper. Explaining why the idea of a low-cost, "mass produced" roadable plane is a long way from realization, the writer examines some of the design and structural problems involved in the creation of a machine that can be used as either an automobile or an airplane. On one hand, he lists 19 features, common in automobiles, which would have to be provided in an acceptable roadable plane; on the other, he indicates requirements on the aeronautical side which have yet to be satisfactorily solved for the low-cost production of



WHEN CARGOES OF FREIGHT REPLACE CARGOES OF BOMBS

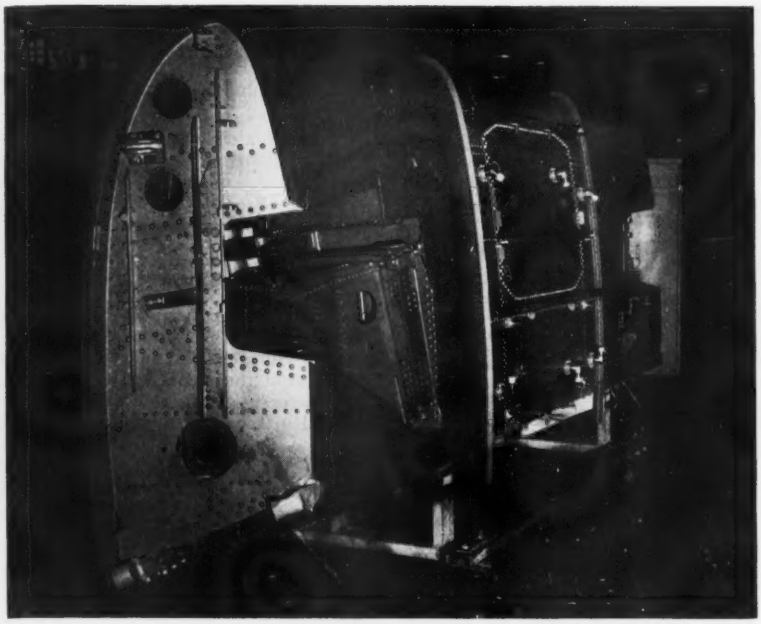
When the roar of motors above signals the passing of freight cargoes, and memories of dropping bombs have been eclipsed by the progress of peace, you can be certain that a large share of the "Freight Cars" of the sky, as well as private planes, will depend on Holley Carburetors. Always known for dependability, Holley Carburetors advanced and improved during war years. In peacetime again, as for almost half a century, carburetors by Holley will set the standard of performance for aircraft and other internal combustion engines.

HOLLEY CARBURETOR COMPANY
5930 Vancouver Avenue, Detroit 4, Michigan

HOLLEY

AIRCRAFT, AUTOMOTIVE, MARINE

CARBURETORS AND ACCESSORIES



Illustrating some of the design and construction features of the TBM-3 Avenger, the above photograph shows the wing center section leading edge assembly ready for the attachment of the trailing edge assemblies at the Eastern Aircraft Division of General Motors Corporation.

such a plane. *Air Facts*, May, 1945, pages 56–60.

TBM-3 Avenger. Part II. The second part of a serial article investigating the design and construction features of the TBM-3 Avenger includes details about the crew accommodations; cockpit equipment; controls; armament and armor protection; fuel tanks and pumps; and landing gear and braking system. It also contains data regarding the plane's hydraulic system; wing flap circuits; ailerons, elevators, and rudders; various flaps; and anti-icing system. Numerous photographs and cutaway drawings illustrate the particulars. *Aero Digest*, April 1, 1945, pages 88–93, 214, 18 illus.

Education

The Wind Tunnel in Undergraduate Instruction and in Research. Wilbur C. Nelson. The writer briefly discusses the merits of the small "undergraduate" wind tunnel for instructional purposes in aeronautical engineering, and the utilization of the relatively small research wind tunnel in the graduate program. The small undergraduate wind tunnel is defined as atmospheric with a test section area approximately 10 sq.ft. or less and a maximum velocity of 100 m.p.h. or less. The research wind tunnel is considered as atmospheric with a test section area approximately 65 sq.ft. in area and a maximum velocity well beyond 100 m.p.h. *The Journal of Engineering Education*, March, 1945, pages 368–370.

An Aeronautics Option in Civil Engineering. A. S. Niles, Jr. In this article the writer points out that a school with a good department of civil engineering, by the addition of a very small number of courses in aeronautical subjects, is able to offer a worth-while option in aeronautical engineering. It is stated that the additional courses required could easily be given by a single faculty member, although it is unusual to find a man who is equally interested in aerodynamics and in airplane structures. *The Journal of Engineering Education*, March, 1945, pages 371–374.

Some Suggestions on the Teaching of Structural Analysis and Related Subjects. F. R. Shanley. It is noted that during the past 15 years the airplane has changed so much that entirely new methods of analysis and engineering procedures have been evolved. Even the organization of engineering activities has changed. Some of the more important developments and trends are mentioned. The influence of such developments on aeronautical engineering education are discussed. *The Journal of Engineering Education*, March, 1945, pages 375–381.

Electrical Equipment

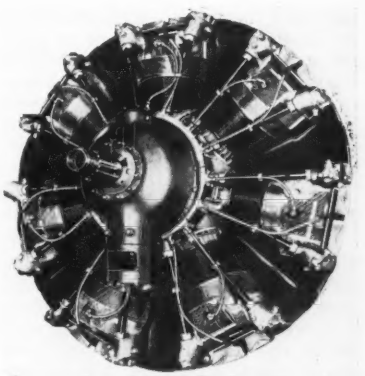
Electronics in Industry. J. H. Reyner. Demonstrating types of problems in which electronics can be of service to the production engineer, this article defines the technique of electronics and explains a few of its applications in the aircraft industry. Applications considered include the use of the electronic technique for the gaging of strains and vibrations; the solving of supercharger problems where the high speeds involved caused the rotor blades to expand radially; dynamic balancing of rotors; the pretesting of electrical assembly-line components; and mechanical gaging. The functions and operating principles of the stroboscope are described. *Aircraft Production*, April, 1945, pages 155–158, 8 illus.

Will Aircraft Switch to 400-Cycle Auxiliaries? J. D. Miner, Jr. This article reviews the progress that has been made in the development of a new a.c. electric system for large aircraft. The project was carried out at the request of the Army Air Forces. Reference is made to the controversy that has arisen regarding the feasibility of using high-voltage direct current at high altitudes. The article describes how the Electric Branch of the Equipment Laboratory at Wright Field set up an a.c. engineering unit to attack the problem. It is stated that neither the comparative reliability of 24-volt and 120-volt direct-current equipment, nor the comparative reliability of 120-volt direct-current and 208-volt alternating-current equipment have yet been established by operating experience, although some experimental and much theoretic evidence is available on these subjects. A general comparison of various electric systems for large aircraft, rated from 24 to 32 kw., is given in the text and summarized in tabular form. *Machine Design*, April 1945, pages 125–130, 190, 6 illus.

Preferred Practices for Electric Control Devices for Aircraft. F. W. Hottenroth, Jr. The writer suggests that the American Institute of Electrical Engineers set up preferred practices for the electric control equipment used on aircraft. As a sample of the type of standards that are considered necessary, a set of proposed standards is provided. Design features of electric control devices that have definite advantages under the conditions encountered on aircraft are described. *Electrical Engineering*, April, 1945, pages 197–200 (Transactions), 6 illus.

Engines

Fuel Injection for the Aircraft Engine. F. J. Wiegand and D. W. Meador. Reference is made to the con-



An artist's drawing of a new seven-cylinder 700-hp. Wright Cyclone engine developed to use either low-cost low octane gasoline to produce its rated horsepower or higher octane for greater power. The engine is proposed for installation in short-haul military transports of "feeder" types.

troversy about fuel injection versus carburetion for aircraft engines. A résumé of previous investigations of the subject is presented. The history of fuel-injection investigations carried out by the Curtiss-Wright Corporation and later by the Wright Aeronautical Corporation is reviewed. Tests made with fuel-injection equipment that is completely interchangeable with carburetion equipment applied to the same basic engine are discussed. Consideration is given to fuel-injection problems that will require further investigation. *SAE Journal*, April, 1945, pages 208–224 (Transactions), 35 illus.

Continental Engines. An engineering analysis of the Model "A" series of aircraft engines manufactured by the Continental Aviation & Engineering Corporation. Accompanied by photographs and schematic drawings, details are given on the design, construction, operation, and performance of these engines. The description takes into consideration each of the component parts and notes how the various engine models differ from each other. Models under discussion include the A-50, A-65, A-75, and A-80. *Aero Digest*, April 15, 1945, pages 82–85, 196, 9 illus.

Flight Operations

How Engineering Can Simplify Cruise Control. James B. Rea. In a discussion of cruise-control techniques, the writer gives a recommended procedure for obtaining the needed engineering data based on flight-test experience, as well as the steps followed in constructing cruise-control charts. The three fundamental techniques are defined as those which provide the highest investment return to the air line, maximum range, and maximum endurance. An explanation is given of the rate of investment return, with an equation for expressing it. An operational analysis is worked out, using as an example the operation of a given number of airplanes carrying cargo between San Francisco and Honolulu. Flight-test procedure is outlined for a complete A.T.A. cost analysis permitting accurate determination of techniques for maximum range and endurance. The text is clarified by charts of indicated air speed, fuel consumption, and mixture setting, as well as a cruise-control table. *Aviation*, April, 1945, pages 161–165, 4 illus.

Flight Technique

Assessing Control Qualities. W. E. Hick. It is noted that in assessing the handling qualities of a projected airplane independently of pilots' opinions of previous types, it is necessary to assume that the functions of the pilot can be replaced by a suitable mathematical expression. The writer presents a compromise method that he believes will be useful. It assumes, in the case of the elevator, that the control column deflection at any instant is proportional to the deviation, a certain fraction of a second previously, of the aircraft's attitude from that desired by the pilot. It is shown that the constant of proportionality, which may be called the pilot's sensitivity or reactivity, is of a similar order of magnitude for some widely differing types (the criterion being the appearance of a continued oscillation), and may therefore serve as an index of one aspect of the handling qualities. *Aircraft Engineering*, March, 1945, pages 70, 71, 4 illus.

Is the Stall Landing Obsolete? John R. Hoyt. Two types of landings—the full stall and the wheel landing—are defined and their comparative merits weighed. Advantages of each type of landing are considered, to ascertain whether one can be used to the exclusion of the other. The conclusion is that, although factors favoring the wheel landing are more numerous, the good pilot must also be familiar with the stall landing because there are conditions where the stall landing is more suitable than the wheel landing. In evaluating the two types of landings, differences between maximum glides, normal glides, and minimum glides are explained. *Flying*, May, 1945, pages 60, 61, 124, 127, 128, 2 illus.

Flight Testing

High-Altitude Factors in Flight Testing. Marvin L. Michael and Sidney R. Silber. The writers discuss some of the difficulties encountered in high-altitude flight testing which are brought about by the low temperatures and pressures existing in the upper regions of the atmosphere. Measures designed to improve propeller feathering at altitude are described. These include relocating the feathering pump at a point beneath the oil tank, bleeding warm oil through the feathering line, reducing the feathering pump capacity, using a propeller dome spinner, and faired-knee cams or reindexed standard cams. Several solutions are suggested also for the oil foaming problem. Consideration is given to the supplying of sufficient inlet pressure and oil density at the pump to prevent reduction of pump efficiency. *SAE Journal*, April, 1945, pages 233–238, 256 (Transactions).

History

Blériot—My Father. Part II. Simone Rubel-Blériot as told to Madeleine Raoul-Duval. Second half of a two-part biographic sketch of Louis Blériot, French aviation pioneer. Part II describes Blériot's flight across the English Channel in 1909. In lesser detail it also reviews other contributions to the progress of aviation made by Blériot—as a pilot; as a record-setter and winner of various air competitions; in the field of manufacture, as constructor of the Spad and the "Santos Dumont" hydroplane; as sponsor of schools for pilots; as founder of air lines; and as a representative on a French aviation mission to the United States. *Air Trails*, May, 1945, pages 37, 80, 82–84, 2 illus.

Inspection

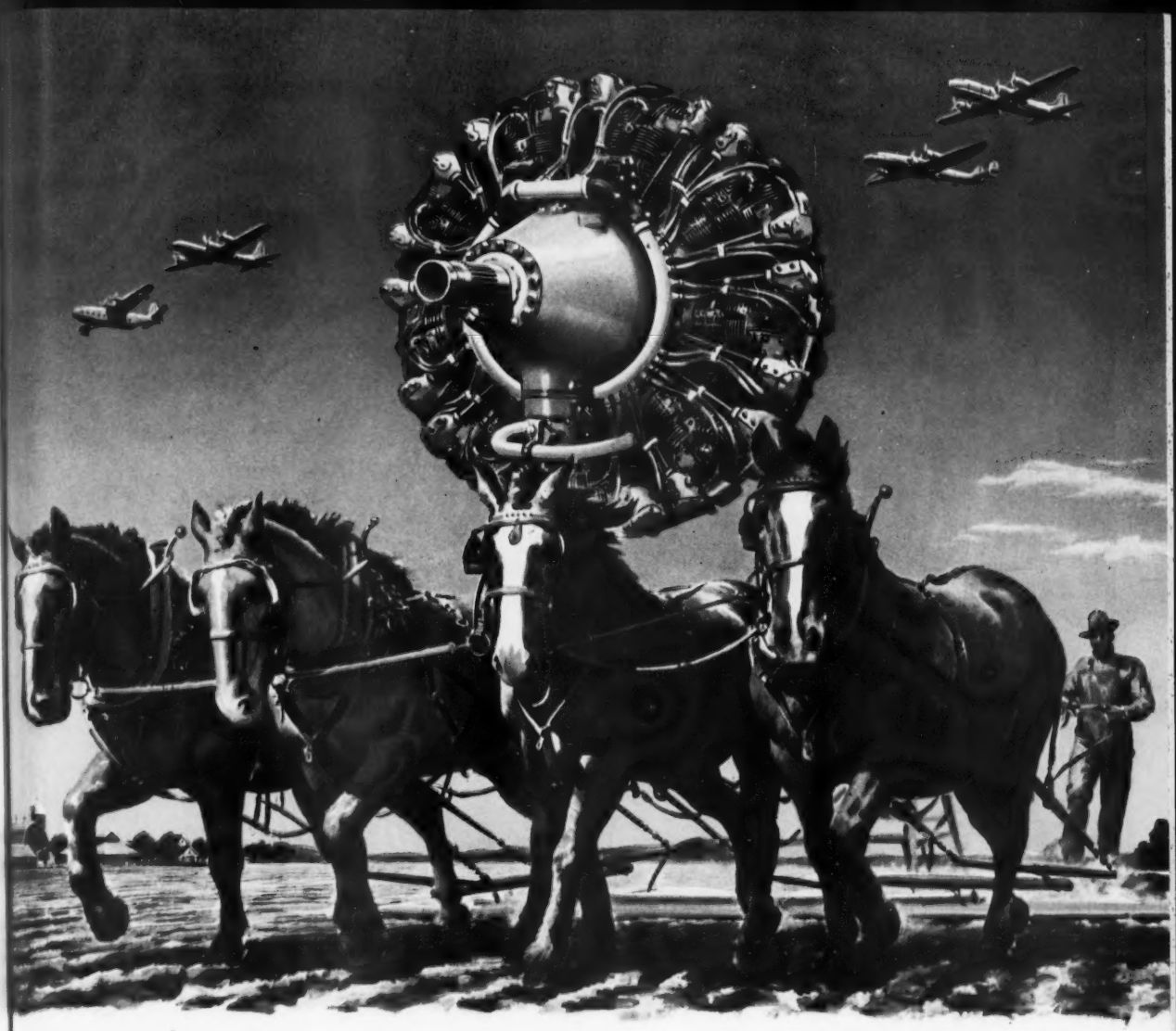
Magnetic Crack Detection. J. E. D. Bell. This is the second and concluding installment of an article on the magnetic system of crack detection. A description is given of the common defects that can be revealed by this system and the machines and jigs used in their detection. *Aircraft Engineering*, March, 1945, pages 88–90, 12 illus.

Instruments

A Means for Warning of Incipient Breakdown of Smooth Airflow over Airfoil Surfaces. R. D. Kelly. The purpose of this paper is to describe in considerable detail the principles involved in the stall-warning system devised by United Air Lines, Inc., and to outline the test results that have been achieved. The system utilizes multiple units sensitive to changes in the characteristics of the airflow mounted on the aft portion of the airfoil and on the low-pressure side, providing electrical contacts that actuate lights or ammeters in the pilot's compartment. The aerodynamic theory upon which the device is based is explained. Reference is made to a paper by James George of the Civil Aeronautics Administration, presented at the 1944 Annual Meeting of the Institute of the Aeronautical Sciences and published in the June, 1944, issue of the AERONAUTICAL ENGINEERING REVIEW, in which the principles were examined and the United Air Lines' unit and several similar devices were described. The steps in the development of the device are traced with particular reference to the requirement that for air-line use it is necessary to anticipate every possible condition of wind, weather, loading, flight technique, as well as other factors. Following a detailed description of the design and construction of the instrument, the writer records the flight tests to which it was subjected, including the measurement of its effectiveness under icing conditions by the application of artificial mixtures or "pseudo ice" to simulate the effects of ice accumulation. *SAE Journal*, April, 1945, pages 201–207 (Transactions), 17 illus.

Automatic Air Navigation. F. H. Scrimshaw and J. A. Wells. This article describes new British equipment that has been designed to maintain an automatic air plot during all normal maneuvers of heavy aircraft, to within an accuracy of 2 per cent of the total air distance covered. Sections of the article are devoted to the gyro-magnetic distant reading compass, the air-mileage unit, and the air-position indicator. Information is given about the principles on which these instruments operate. *Aircraft Engineering*, March, 1945, pages 64–69, 10 illus.

The Distant Reading Gyro-Magnetic Compass. Part II. This is the second part of an article discussing the design of the distant reading gyro-magnetic compass. Information is given about the three-wire electric system by which indications of the dis-



Workhorse Power

CYCLONE 18

Planes powered by Wright Cyclone 18's carry more pounds—in bombs, gasoline, passengers or cargo—than any other aircraft.

In the Lockheed Constellation and Boeing C-97, they carry loads at speeds no other transport can match. In the Martin Mars, they carry cargo at a new low for ton mile costs. In the Boeing B-29, they have carried more bombs over a greater range than any other plane ever sent into action. In still other planes, not yet released, Cyclone 18's continue their record performance.

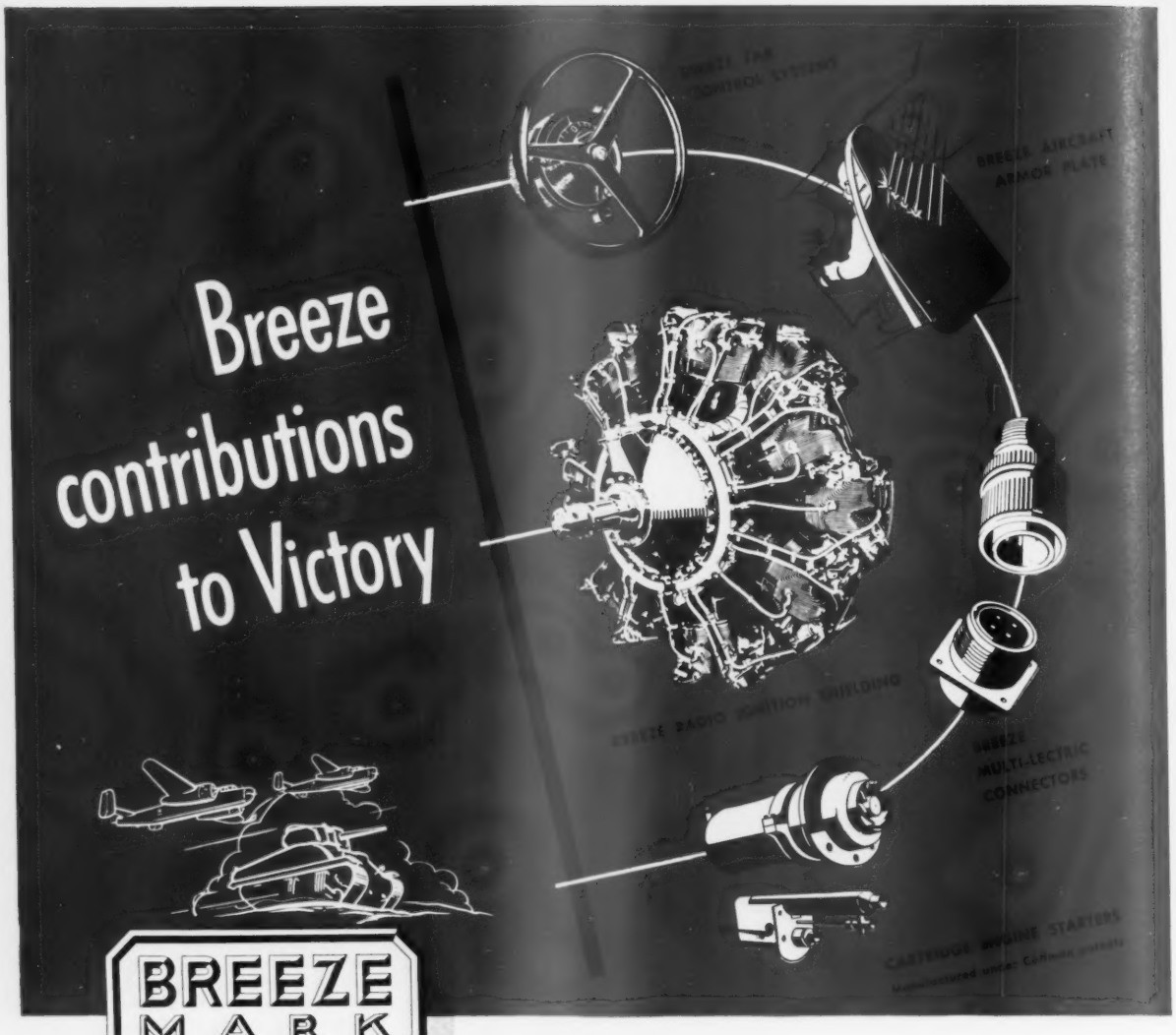
This is workhorse power. It is economical, reliable, rugged power. It is workhorse power that is adaptable to a wide variety of aircraft: bombers, flying boats or transports. And it is adaptable to a wide variety of installation problems. It is power that is light in weight, thrifty on fuel and low in cost. It is power for war or power for peace. It is power for today and is growing into far greater power for tomorrow.

Wright Aeronautical Corporation • Paterson, New Jersey, U.S.A.

CYCLONE EXPERIENCE MEASURED BY MILLIONS OF HOURS

Each 100 bombers raiding Tokyo add 6,000 more hours to the Cyclone 18's flight time. Exclusive use of this Cyclone for a sustained Pacific offensive has rolled up millions of hours of operating time, proving it the most experienced engine in its power class.

WRIGHT
AIRCRAFT ENGINES
DIVISION OF
CURTISS WRIGHT
FIRST IN FLIGHT



• During the war years, Breeze has produced in vast quantities essential equipment for our armed forces of land, sea and air which have helped bring Victory in Europe. Among the products which have borne the Breeze Mark of quality through wartime service are Breeze Radio Ignition Shielding Assemblies, Multi-lectric Connectors, Aircraft Armor Plate, Tab Control Systems, and Cartridge Engine Starters.

The diversified facilities and skilled hands which helped turn out this vitally important equipment will be available when final Peace comes to pitch in on the big job of reconversion. Until that time, the men and women of Breeze rededicate themselves to the task in hand — to keep production rolling on to ultimate Victory.

BREEZE

Corporations Inc.

NEWARK BREEZE NEW JERSEY

Other Breeze Products • FLEXIBLE METAL TUBING • SHIELDING CONDUIT • FITTINGS • FLEXIBLE SHAFTING

placement of the inner frame are transmitted to the repeater compass. The design of the variation-setting corrector also is described. *The Engineer*, March 9, 1945, pages 188–190, 5 illus.

The Marconator. Charles B. Bovill. A description of the design, operation, and aircraft applications of a semi-automatic wireless device with which highly accurate loop bearings may be obtained from any receivable signals on medium or long radio waves. Reported to be a combination of the latest radio technique with the repeater master compass, the Marconator obviates the need for calculations in ascertaining direction. It is a development of Marconi's Wireless Telegraph Company, Ltd., and was designed for use with the standard Air Ministry direction-finding receiver.

Some of its practical applications as a navigational instrument which are detailed in the article include its use for taking bearings from which a "fix" can be obtained; flying a straight course; flying on a back bearing. Illustrations of the instrument and its component parts are shown. *Flight*, March 22, 1945, pages 306–308, 5 illus.

Your Pitot Head. Wolfgang Langewiesche. An interpretation of the functions and operating principles of the pitot-static head. The effect of this instrument component upon the functioning of the altimeter, the rate-of-climb indicator, and the air-speed indicator is discussed at length. Consideration is given to different possible locations for the pitot head and the various "position errors" that result from each position. *Air Facts*, May, 1945, pages 70–74, 76–80, 2 illus.

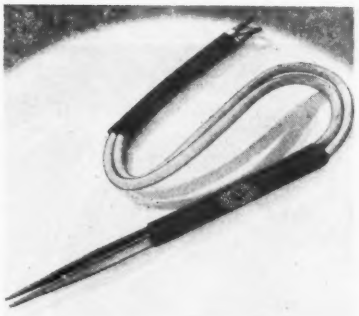
Lubricants

New Spark Plug Thread Lubricant. E. L. Flood. Particulars are given regarding tests of a new graphite-base antiseize compound, designated as GPD-907, applied to the threads of aircraft-engine spark plugs for the purpose of preventing them from seizing in the cylinder. It is stated that the new compound proved superior to 14 other lubricants tested. Illustrations show the condition of the threads of spark plugs lubricated with the new compound and with a mica-base lubricant.

A table gives the torque inch-pounds required to remove spark plugs lubricated with GPD-907 compound and with Spec. 3587 mica-base compound. *Industrial Aviation*, April, 1945, pages 30, 31, 95, 101, 2 illus.

Maintenance

Controlled Airplane Overhaul. Lt. Comdr. D. A. Wrigley. The writer describes a system of controlled airplane overhaul which is based on an analysis of the various factors that are intimately involved with overhaul procedure and the evolution of these factors. Steps in the creation of a flow chart for processing and of an overhaul flow chart are outlined. *Aviation Maintenance*, April, 1945, pages 46–49, 132, 134, 136, 1 illus.



Developed originally to weld radio tube wires of 0.003 in. outside diameter, Besco spot-welding tweezers, manufactured by the New Jersey Jewelers Supply, are stated to be equally useful in instrument work and other kinds of fine workmanship. The tweezers operate on from $\frac{1}{2}$ to 1 kva. power at 10 amp. and are used with a timer that cuts the current and times the length of the weld.

Trouble Shooting "The Elimination Way." Part III. E. F. Lindsley. In the third article of a series examining the various phases of aircraft engine service and overhaul, a specific system of locating and identifying engine difficulties is discussed and illustrated. This process is the checking of one possibility after another, and, by means of elimination, finally locating the seat of trouble. For illustration, the diagnosis and treatment of an engine showing "rough operation" symptoms are traced step by step. *Aviation*, April, 1945, pages 151–153, 3 illus.

Intercontinental Maintenance. Arthur W. D. Harris. This article describes the maintenance-control system of the Intercontinental Division of Transcontinental & Western Air, Inc., which is at present servicing Army Air Forces airplanes assigned to the North Atlantic Division of the Air Transport Command. The main base is at the Washington National Airport. Maintenance operations are divided into four major subdivisions, overhaul, service, inspection, and planning. Functions of the Equipment Committee, which is called the heart of the maintenance-control system, are outlined. Information is given about periodic inspections and inspections designed to provide maximum aircraft utilization. *Aviation Maintenance*, April, 1945, pages 37–45 8 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Applying Leading Edge. It is noted that the leading edge of a Dural or plywood aircraft wing must be preformed before installation. Brief instructions are given for carrying out this work. An iron pipe is used to form the curve at the nose of the leading edge. It is suggested that long beams be used as a jig to support the two edges of the plywood while the material in the middle is pushed down by the iron pipe. *Aviation Service Magazine*, March-April, 1945, page 28, 2 illus.

Materials

See Promise in Papreg for Aircraft Structures. R. J. Considine. From described tests conducted by Douglas Aircraft Company laboratories, data are given on the physical properties of paper-base laminates combined with plywood and their adaptability for aircraft structures requiring high-strength materials. Tables, graphs, and examples help to define the conclusions with regard to the strength characteristics of Papreg materials. General conclusions are summarized as follows: (1) Papreg with an ultimate tensile strength of 31,300 lbs. per sq.in. and a specific gravity of 1.36 compares favorably with 24 ST aluminum on a strength-weight ratio basis; that is, it would have a reduced ultimate tensile strength of 23,000 lbs. per sq.in. per unit s.g. as compared with 23,700 lbs. per sq.in. per unit s.g. for 24 ST (specific gravity of 24 ST is 2.7). (2) Because of the method of fabrication—laminating from thin impregnated sheets of paper—many strong and complicated shapes can be created and readily formed with the aid of a bag-molding operation. (3) Wood strength-properties can be greatly increased by the addition of Papreg material bonded to the outer faces; in this manner, wood structures can be designed to carry loads far in excess of the normal wood strength. (4) The Papreg material does, however, suffer from low elongation and consequent low resistance to stress concentration; assembly methods such as bolting or riveting would necessitate a reduction in the allowable strength of the material. *Aviation*, April, 1945, pages 142–144, 255, 257, 259, 261, 15 illus.

Selection and Preparation of Aluminium Foundry Alloys. E. Carrington. In this article the writer classifies aluminum alloys for foundry use from the standpoint of technical and economic considerations. Tables give the properties of high-, medium-, and low-strength aluminum foundry alloys. Appropriate specifications are systemized. Information is given for the foundryman who prefers to make his own alloys by melting aluminum together with so-called "hardeners." These processes are discussed. *Light Metals*, March, 1945, pages 103–110.

FLEX·O·TUBES Help B-29's DELIVER BOMBS TO TOKYO

The big superfortresses carry Flex-O-Tube hose assemblies in air pressure lines, oil lines, fuel lines and hydraulic lines. These ships can travel faster, higher and farther than any other heavy bomber in the world. Flex-O-Tubes are trustworthy.

THE Flex-O-Tube COMPANY

LAFAYETTE at 14th AVE., DETROIT 16, MICHIGAN
Offices: CHICAGO · FORT WORTH
LOS ANGELES · NEW YORK
SEATTLE · TORONTO, ONT.

Medicine

Nervous System Dysfunction in Adaptation to High Altitude and as Postflight Reactions. Capt. Gordon A. Brown, Capt. Charles H. Cronick, Capt. Hurley L. Motley, Lt. Col. Elmer J. Kocour, and Lt. Col. Walter O. Klingman. An account of studies conducted to observe the effects of decreased atmospheric conditions upon the nervous system. Types of reactions are examined under the following categories: (1) Disturbances of equilibrium and coordination; (2) disturbances of function of the large sensory and motor tracts; (3) disturbances of consciousness and cortical function in the nature of amnesia, confusion, and disorientation; (4) disturbances suggestive of meningeal irritative phenomena, increased intracranial pressure and migraine-like features; (5) disturbances of subcortical mechanisms associated with phenomena of dyskinesia, hyperkinesia, and aphasia; (6) scattered nervous system disturbances of minor character. The conclusions are (1) Dysfunction of the nervous system of severe degree occurs not only during the period of great change in atmospheric pressure but after exposure to conditions of high altitude and return to ground level despite a constant oxygen supply. (2) Symptoms of severe nervous system dysfunction are not immediately or shortly relieved by continued administration of oxygen. (3) Recovery in all cases was fairly prompt and was without detectable residuals. Patients observed were without shock and circulatory collapse of severe degree. (4) The percentage of serious acute reactions of all types, exclusive of those referable to the nervous system, during and following adaptation to high altitude is exceedingly low. Those involving the nervous system alone are only a very small percentage of these reactions. The actual per cent incidence of reaction with symptoms referable to the nervous system during adaptation to high altitude and as postflight reactions was only 0.28 per cent in the group observed. (5) There seems to be no one portion of the nervous system more resistant or more vulnerable than another to the effects of simulated high altitude with mild anoxia. *War Medicine*, March, 1945, pages 157–161.

British Medical Research in Aviation. Flight Lt. Alan Walbank. The medical research work in connection with aviation which has been carried out by Britain's Royal Air Force since 1934 is outlined. Problems of altitude, night flying, and high speed, with which the Central Medical Establishment and Flying Personnel Research Committee had to deal in investigating means of fitting the aviator to his plane and his equipment are reviewed, and the solutions found for some of these problems are noted. Air Marshal Sir Harold Whittingham is credited with having been the moving spirit in the organization and conduct of this research work. *The Military Surgeon*, April, 1945, pages 322–325.

Physiologic Abnormalities and Pathologic Changes Following Exposure to Simulated High Altitudes. Major Alfred F. Goggio and Lt. Col. George H. Houck. This report deals with certain abnormal reactions to simulated high altitudes which occur relatively rarely in low-pressure chambers. The reactions are classified as neurocirculatory collapse at 18,000 ft.; high-altitude reactions (30,000 to 38,000 ft.) including neurologic reactions and myocardial damage; and high-altitude shock. Through experiments, which are described, it was found that certain physiologic and pathogenic disturbances may develop in human subjects on exposure to the high altitudes attained by military aircraft. While deleterious reactions from altitude per se are concluded to be exceedingly rare, hemoconcentration and shock at extreme altitudes, as well as cardiac and neurologic lesions, do develop in some cases. It is stated that death may occur from these causes. *War Medicine*, March, 1945, pages 152–156, 1 illus.

Metallurgy

Softening of Cold-Worked Aluminum. J. K. Stanley. The softening of pure aluminum that has been work-hardened is discussed in general terms in the light of some rather recent knowledge. It is explained that during the heating of the cold-worked aluminum two processes occur. First, the aluminum goes through a recovery period in which most of the internal stresses are relieved and there is a slight change in hardness. Second, the aluminum can undergo recrystallization by which strain-free nuclei grow in the cold-worked matrix. The phenomenon results in an isothermal recrystallization curve which is governed by the cooperation of the rate of nucleation and the rate of growth. Large changes in hardness occur during recrystallization.

The aluminum after recrystallization on prolonged annealing, particularly at elevated temperatures, undergoes a change in grain size attributable to grain growth. This growth becomes very aggravated at temperatures above 500°C. especially if the material is pure and long annealing times are used. *Aluminum and Magnesium*, pages 20–23, 33, 7 illus.

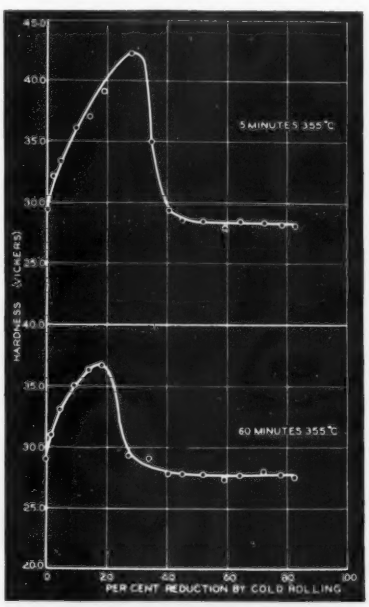


Photo Courtesy Aluminum and Magnesium Magazine

Curves showing changes in hardness due to recrystallization caused by heating cold-rolled aluminum. The time required for softening of material cold worked over 30 per cent is of the order of 5 min. or less. At higher temperatures the time for softening would also be hastened.

Military Aviation

Fighting the Jet Fighter. James L. H. Peck. An account of the fighting patterns employed by pilots of German jet- and rocket-propelled planes and of the air-combat tactics evolved by the Allies to oppose them. Of opposing tactics it is said that, in general, they involved forcing the jet- and rocket-propelled planes to turn as much as possible and to make head-on attacks. Some details about the design and performance characteristics of three reaction-propelled German aircraft are included in the article. These are the Me 163, Me 262, and He 280. *Flying Age*, May, 1945, pages 10, 11, 62–67, 7 illus.

Master Bomber in Action. Frank Tilsley. An interpretation of the Master Bomber's functions in the operations of the Royal Air Force. His duties are reported to encompass the direction of bombers to the actual target, checking the falling of the bombs, and instructing each fresh wave of attacking aircraft how to drop their bombs. The method by which the Master Bomber communicates with the airplanes in his group is usually by radio telephone from an aircraft participating in the air raid. *Canadian Aviation*, April, 1945, page 138, 1 illus.

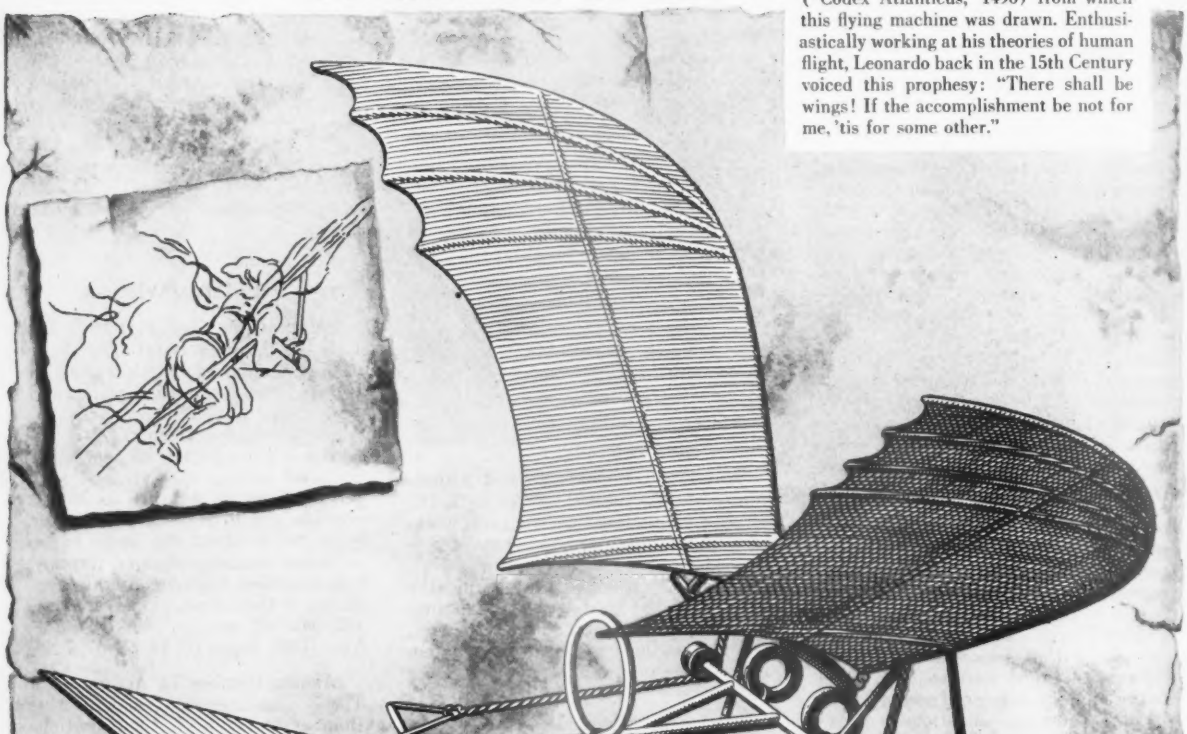
Paints and Coatings

New Magnesium Anodizing Process. James C. Fuller. This article describes the anodizing method for coating magnesium alloys developed by two research chemists of Consolidated Vultee Aircraft Corporation. It is stated that magnesium, anodized by the Simpson-Cutter process, is now being used for aircraft dorsal fins, tail coatings, trailing edges of wings, instrument panels, seats, and general furnishings. The new process makes it possible for magnesium to be polished to a high luster and waxed. It is explained that magnesium can be anodized in any color and that the surface is more wear-resistant than paint. Details are given regarding the operation of the process and how it was discovered. *Aluminum and Magnesium*, March, 1945, pages 20, 21, 28, 29, 43, 9 illus.

THE WINGS OF LEONARDO da VINCI

. . . were low on LIFT

Years before he painted the Mona Lisa, Leonardo da Vinci sketched the designs ("Codex Atlanticus," 1490) from which this flying machine was drawn. Enthusiastically working at his theories of human flight, Leonardo back in the 15th Century voiced this prophesy: "There shall be wings! If the accomplishment be not for me, 'tis for some other."



Courtesy, the Smithsonian Institution

"*Lift*" is caused by air passing over a wing and is what makes an airplane fly. "Drag" is the resistance of air to the plane's passage and is what fights against the airplane leaving the ground.

In fact, you can trace the progress of human flight in the battles of Lift versus Drag. You can trace it in progressively lighter and more powerful propulsion... from the Wright brothers' 12-horsepower engine to today's great multi-bank motors, and on into gas turbines and jet propulsion.

You can trace it in the step-by-step reduction of Drag... from guy-wired biplane through cantilever internally-braced monoplane wing and the all-metal stressed-skin fuselage (both Northrop "firsts"). And you can trace increasing usefulness and control of Lift surfaces through developments like the Northrop retractable aileron, as used on Northrop's P-61 Black Widow.

What next? Northrop's peacetime goals include far-reaching advancements in propulsion . . . and aircraft designs like the Flying Wing, in which nearly every part contributes to Lift. Northrop Aircraft, Inc., Hawthorne, Calif.

The Black Widow now night-fighting on world battlefronts. Designed and mass-produced by Northrop

NORTHROP *Creators of the* ***Flying Wing*** *and the* ***Black Widow*** *P-61 Night Fighter*

LOOK AHEAD — BUY A BIGGER BOND TODAY

Official United States Navy Photograph

Vought Corsairs, their wings studded with rockets, line a carrier deck just before a Pacific strike.

Plants

Magnesium Foundry. Parts I, II, and III. These are the first three installments of an article describing a large British foundry that was laid out solely for the production of magnesium castings. It is noted that this foundry, which is at one of the J. Stone and Company's works, embodies many interesting features with regard to general layout, mechanical aids to production, and ventilation. Sections of the first installment are devoted to the general layout of the foundry, the working conditions and ventilation, and the plant and its equipment.

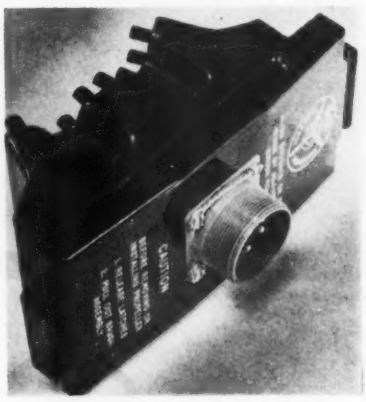
In the second installment the general layout of the mechanized section of the foundry is discussed. Information is given about the layout and equipment of the core shop, furnace room, the light machine molding section, and the pendulum conveyer.

The third installment deals with the heavy molding section, the sand conditioning section, the fettling shop, and the heat-treatment department. *The Engineer*, March 30, 1945, pages 245–248, 3 illus.; April 6, 1945, pages 267–269, 7 illus.; April 13, 1945, pages 287–289, 3 illus.

Plastics and Plywood

The Propeller Brush Holder. Maurice E. Cushman. A description is given of developments in propeller brush-holder design which illustrate the wide range of design possibilities presented by molded plastics for the solution of otherwise difficult problems. The brush holder is used, with its related parts, to transmit electric power from the aircraft power supply to the pitch-change mechanism in the rotating propeller. The writer tells how the development of molded brush holders eliminated troubles experienced with the type of built-up brush holders formerly used. *Modern Plastics*, April, 1945, pages 140–142, 192, 194, 8 illus.

High Strength Thermoplastic Tooling Material. A description is given of Plastiform, a plastic tooling material developed by the Duorite Plastics Industries, which is stated to possess high strength and to be 100 per cent salvageable. It is stated that after casting this thermoplastic can develop a compressive strength of as much as 15,000 lbs. per sq.in. It then can be sawed, sanded, or drilled like wood. The article states that Plastiform is currently being used in several West Coast aircraft factories for the fabrication of profile or Keller duplicating blocks, blueing blocks, master contour models or mock-ups, master checking fixtures, stretch-press form blocks, contact laminating forms, protective coverings, and molds for casting other materials. The new product has a melting point of 240°F. and can be used to produce individual castings in 4 min. Its physical properties are listed. *Industrial Aviation*, April, 1945, pages 68, 70, 101, 4 illus.



A molded phenolic propeller brush holder used to transmit electric power from the aircraft power supply to the pitch change mechanism of the rotating propellers. All parts of the six-row brush assembly are molded, thereby eliminating a cast aluminum-alloy cap.

Residual Stress in Formed Methacrylate Sheeting. R. Richardson. It is noted that there is a certain loss of material and labor in the aircraft industry through breakage of formed plastic sheeting during and after installation. Particulars are given about laboratory tests that indicated that residual stress in the formed sheeting was the cause of breakage trouble. A study is made of the causes of residual stresses and means of preventing them. It is suggested that the annealing of complete aircraft canopies be given a commercial trial on a scale not possible in the laboratory. *Plastics and Resins*, March, 1945, pages 15, 16, 33, 36.

Private Flying

The Doctor Says No! James W. Batchelor. A protest is made against the medical regulations connected with the obtaining of a private pilot's license. From surveys made by the United Pilots & Mechanics Association, specific cases are noted to support the writer's claims that some of the physical requirements are unreasonable and unnecessary, that interpretation of the medical regulations has erred toward the overstringent, and that these regulations as they stand now are a deterrent to private flying. *Southern Flight*, April, 1945, pages 25–27, 40.

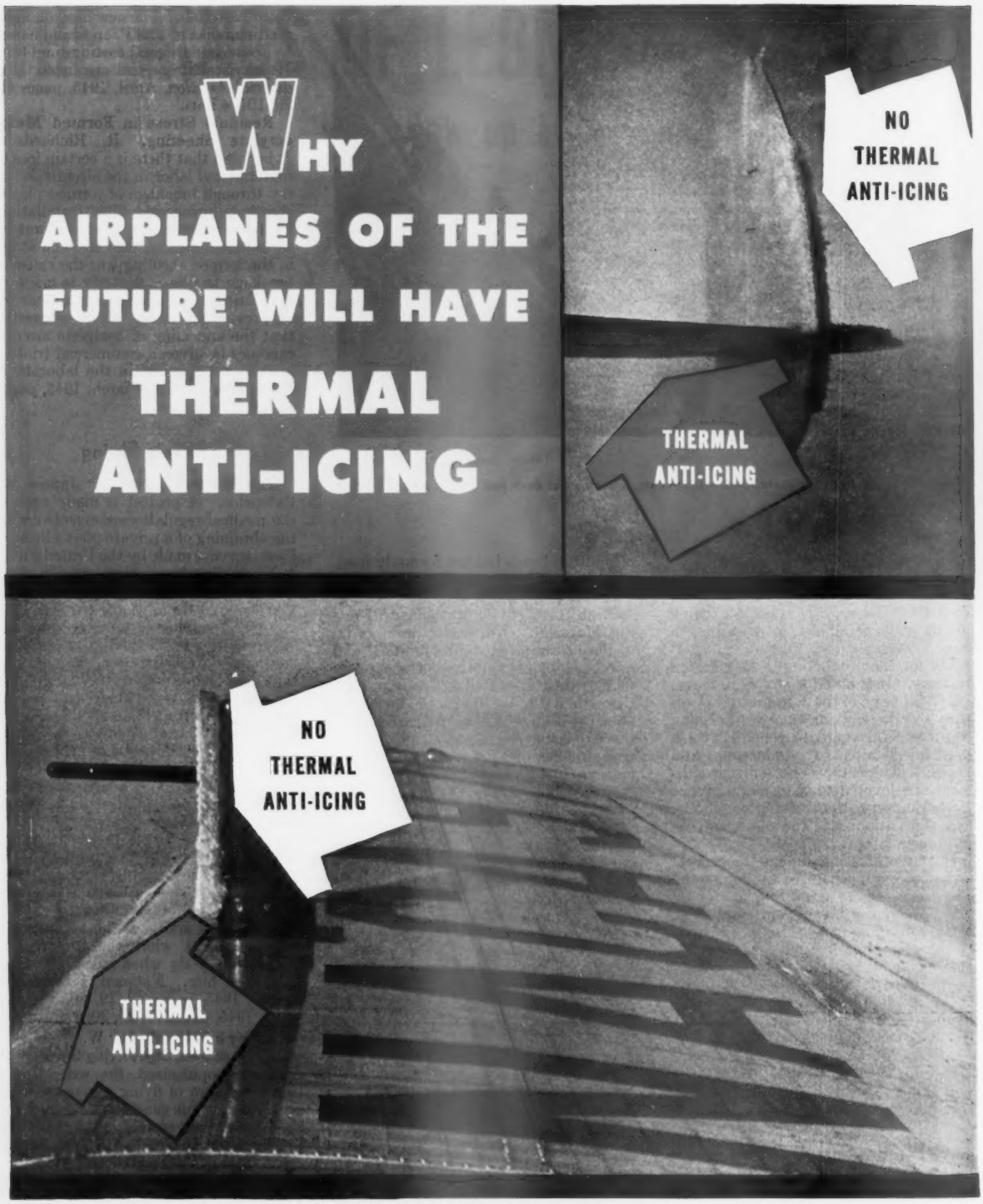
Buying a Plane? William D. Strohmeier. Types of postwar planes that will be available for the private flier are discussed in the first of a series of articles giving advice to beginners in aviation who are thinking of buying a plane. Particulars are given regarding three categories of aircraft that are being developed for the postwar market. Factors that must be considered in evaluating an airplane are discussed.

The second article of this series gives pointers about what the prospective buyer should do when salesmen start calling on him. *National Aeronautics*, March, 1945, pages 18, 19, 26, 3 illus.; April, 1945, pages 17, 29, 30, 1 illus.

Money by Moonlight. W. W. Ward. Urging that local night flying for private pilots be popularized, the writer indicates this form of flying as one possible source of revenue generally neglected by operators. He refutes the theory that night flying is much more dangerous than day flying and suggests several comparatively inexpensive procedures by which the operator can meet traffic or lighting requirements for night flight. *Air Facts*, May, 1945, pages 11–14.

Aeromotoring Tomorrow—or Not? Cyril May. The postwar prospects for private and sporting flying are discussed. The situation in America is compared with that in Great Britain. The writer examines the question of controls, outlines the kinds of aircraft that may receive the approval of the purchasing public, and notes price possibilities. *Aeronautics*, April, 1945, pages 38, 39.

WHY AIRPLANES OF THE FUTURE WILL HAVE THERMAL ANTI-ICING



Actual Unretouched Photographs—Courtesy of National Advisory Committee for Aeronautics

Another Product of STEWART WARNER

South Wind REG. U. S. PAT. OFF.

West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service

Actual Unretouched Photographs—Courtesy of National Advisory Committee for Aeronautics

TODAY, thermal anti-icing is on the job in our huge cargo ships and bombers. It is proving itself to be the answer to icing conditions in the toughest kind of weather. It is saving lives and enabling missions to be flown that otherwise would be an impossibility. On today's performance alone, greater safety from icing is definitely assured —now and for the future.

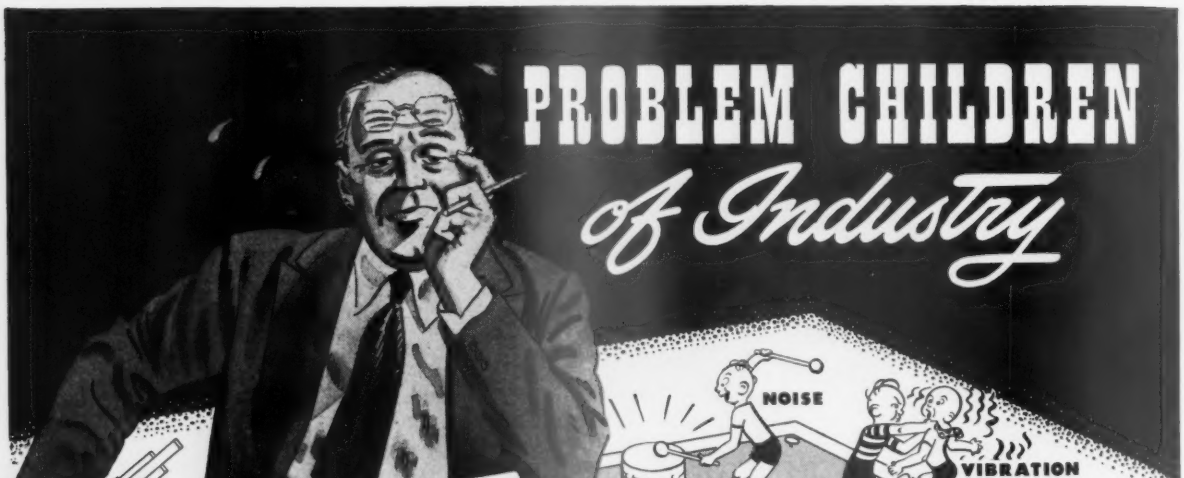
The reasons for the superiority of thermal anti-icing are simple. It can provide *complete* protection *against* the formation of ice on wings. It can be made so *simple* that its operation does not require any special skill on the part of the pilot. The use of heat sources with the reliability and long life of those made by South Wind can make thermal anti-icing systems practically *free from service* or maintenance problems.

For instance—to date, 9000 South Wind heat exchangers have been installed on combat aircraft. Many of these exchangers have been in continuous service for approximately a year. *There has not been one report of exhaust gas leakage—except through battle damage.*

Heating

HEATER DIVISION, STEWART-WARNER CORPORATION, CHICAGO 14, ILL.

1273 *Westwood Boulevard, West Los Angeles, California*



IF THEY PESTER YOUR PRODUCT CALL ORCO

VIBRATION . . . SHOCK . . . FRICTION . . . . CORROSION . . . these and many other destructive "imps" are the *"problem children of Industry."* Uncontrolled, they wreak havoc with good products . . . impair product efficiency . . . shorten product life.

Not in all cases, but in an immense number of cases, these *"problem children of Industry"* can be . . . *and are* . . . brought under control by correct applications of rubber and synthetic rubber.

A whole new world of "rubber controls" was cracked wide open by the impact of war. Pre-war limitations in the applications of rubber and synthetic rubber were swept aside in the drive for new materials and improved methods of compounding, molding, extruding, calendering, coating and bonding.

Today, and in the tomorrow to come, Industry can . . . *and will* . . . look to rubber and synthetic rubber to a greater degree than ever for solutions to the countless problems of product development in a highly competitive world.

ORCO (The Ohio Rubber Company) is not resting on its wartime achievements. ORCO research facilities are under constant expansion. ORCO production methods and equipment are under progressive development.

The ORCO goal is still greater control of the "problem children of Industry."

YOUR inquiries on specific problems are invited.

"ORCO-OPERATION"

BRANCHES: DETROIT • NEW YORK • CHICAGO
INDIANAPOLIS • WASHINGTON • CLEVELAND

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

Production

Melting and Pouring for Magnesium and Aluminum Alloys. Alexander McIntosh. Particulars are given regarding melting and pouring operations as applied to the manufacture of aluminum and magnesium aircraft castings. Foundry practice for magnesium is discussed first. Information is supplied about the physical control of the castings, the types of crucibles used, how the surface of the crucibles is protected by a treatment with aluminum, and the inspection system used for checking the soundness of the crucibles. Melting, stirring, and dusting procedures are described. Consideration is given to the fluxes that are used primarily for protection of the metal during the melting-down stage.

Similar information is given about the melting and pouring of aluminum. Standard pouring procedure for all metals is shown in tabular form. *Aluminum and Magnesium*, April, 1945, pages 16–19, 33, 34, 8 illus.

Production Engineering Key to Lower Costs. George E. Haddaway. A nontechnical discussion is given of the production methods that were adopted in order to reduce construction costs for the Republic Seabee amphibian. New techniques were created for simplifying the production methods used in fabricating the air frame, so that the cost to the postwar purchaser of private aircraft could be lowered. The article describes briefly how the new methods were applied to the wing construction and how the methods were proved by test. Illustrations show the construction of the stabilizer and the wing and a chart gives a comparison of the labor costs under the modified plan with the former method, giving effect also to the improvement obtainable with special tooling. It is stated that similar methods for cost reduction can be applied to other parts of the airplane. A brief sketch of the career of Alfred Marchev, President of the company, concludes the article. *Southern Flight*, April, 1945, pages 34, 35, 68, 5 illus.

Centerless Grinding of Screw Threads . . . A Revolutionary Development. Particulars are given about a centerless thread-grinding method developed after 2 years of experimental investigation and testing in actual production setups. Changes that have been made in the design of the No. 12 centerless grinding machine produced by the Landis Tool Company, to adapt it to thread grinding are described. It is stated that the centerless grinding method has been successfully applied on a commercial scale to the grinding of hardened socket set screws from $^1/_4$-in. to $^5/_8$-in. diameter with pitches from 40 threads per in. to 11 threads per in., and that thread diameters up to 5 in. and thread length up to 12 in. have been successfully handled. Various types of work threaded on the newly developed machine are described and illustrated. *Machinery*, April, 1945, pages 188–195, 9 illus.; "Centerless Grinding of Screw Threads," by James R. Custer, *Automotive and Aviation Industries*, April 1, 1945, pages 23, 108, 110, 2 illus.

Cyclone Expediters Use a Signalled Record. Gustav Maass. This article describes the new expediting record used at the Cincinnati plant of the Wright Aeronautical Corporation. A visible system was developed which gives delivery status at a glance to both expediter and supervisor with a minimum of clerical work. Illustrations of the record cards are shown. *Wings*, April, 1945, pages 1492–1497, 7 illus.

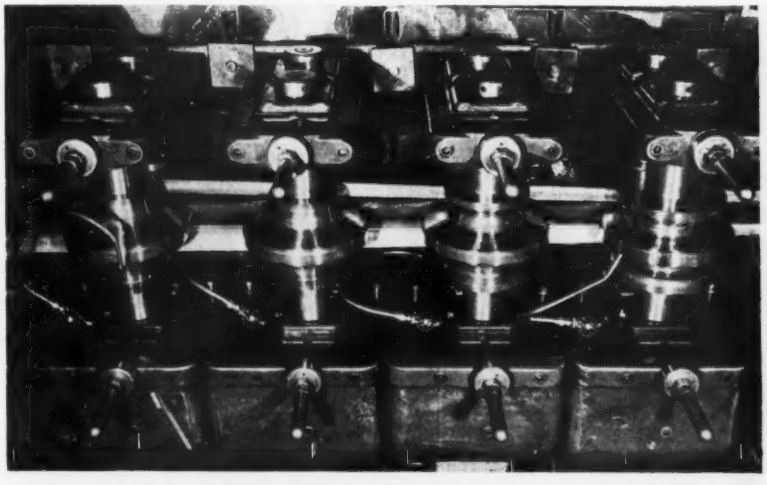
Labor Turnover No. 1 Problem at Aircraft Plants. Donald W. Douglas. The President of the Douglas Aircraft Company discusses the labor problems that the aircraft industry had to solve in raising airplane production from 2,141 in 1939 to 96,369 in 1944. He tells how the number of employees in aircraft plants was increased from 48,000 in 1939 to 2,000,000 in 1943, and of the gain in efficiency whereby an increase of 665 per cent in personnel from 1940 to 1944 accomplished an increase of 2,840 per cent in production. He also discusses other phases of the task of building superior air power. *Automotive and Aviation Industries*, April 15, 1945, pages 19, 109.

Damage Control. Gaither Littrell. The writer describes methods employed by the Douglas Aircraft Company for the control of damage to aircraft parts and materials during the receiving, storage, and installation periods, and while they are in use on planes prior to delivery. Rules were established for handling materials and parts, and for storing, transporting, and packaging. Instruction books containing photographs showing the right and wrong way to handle and pack parts were issued. Colored identification tape was used to mark cartons containing items requiring especially careful handling, and to designate the conveyer box to be used for parts. Protective materials for wrapping parts are described. *Industrial Aviation*, April, 1945, pages 41, 42, 44, 45, 98, 9 illus.

Negative Rake Machining. Part I. First installment of a two-part article surveying the advantages of using milling cutters or lathe tools having negative rakes instead of the normal positive rake. In addition to an explanation of the technique, Part I contains experimental data, obtained under workshop conditions, which demonstrate that negative rake machining with tungsten carbide tools effects economies in production. Conditions necessary for the efficient use of the method are noted. On the basis of results so far achieved it is predicted that negative rake machining for ferrous materials will be used extensively in the future and that machining time cycles will thereby be reduced.

Six tables summarize the reported data. One shows the results of feed and speed experiments carried out on a No. 4 Cincinnati horizontal milling machine; another the results of a series of tests made on a Milwaukee vertical milling machine fitted with a 5 hp. motor that was overloaded. Table III provides data regarding a series of experiments made with Galtona cutter fixed with Wimet-tipped teeth arranged to provide a 10° negative rake and helix angle. Various feeds and speeds recommended by manufacturers of tungsten carbides are listed in Tables IV and V. The sixth table illustrates economies effected in one factory by changing over from high-speed tools to negative rake equipment. *Aircraft Production*, April, 1945, pages 200–202, 4 illus.

Deep Drawing Magnesium Domes. J. Walter Gulliksen. The development of a technique for the hot deep-drawing of magnesium propeller domes from heavy-gage stock is described. It is explained that the Worcester Pressed Steel Company selected the propeller dome that houses the feathering mechanism of the Hamilton Standard propeller for



A Yoder roll-forming machine progressively reduces a flat magnesium strip to a finished hat section at the Ft. Worth Division of Consolidated Vultee Aircraft Corporation.

further experiments in deep-drawing magnesium because this unit would involve a whole series of press operations. The domes had been in quantity production in aluminum at this plant. Sections discuss the hot drawing operation, the "ironing" process, final hot forming, and lubrication and cleaning. It is stated that the results furnish evidence of the plasticity and formability of magnesium when the proper methods are used. *Metals and Alloys*, April, 1945, pages 986–990, 9 illus.

Roll Forming of Magnesium Alloys. John M. Thompson, Jr. This is a report on a series of laboratory control tests carried out by the Consolidated Vultee Aircraft Corporation. These tests were conducted to determine which of the various commercial magnesium alloys develops optimum design properties and to determine under what conditions these alloys can be cold formed. The results of these tests indicated that the alloy AM-C52S-O, or its equivalent FS-1a, had the optimum combination of compressive yield strength and formability. It was found that the yield strength of this alloy could be increased an appreciable amount by stretching, the increase being proportional to the percentage of stretch imposed upon the material. It was also found that AM-C52S-H (FS-1h) could be formed after it was partially annealed. Particulars are given about the procedures for roll forming which were developed following findings reached through the tests. *The Iron Age*, April 26, 1945, pages 53–55, 5 illus.

Shot Peening Now Widely Used for Increasing Fatigue Resistance. Charles O. Herb. The writer discusses the use of shot peening for increasing the fatigue resistance of stressed metal parts, including gears, crankshafts, connecting rods, and aircraft propeller blades. Reference is made to two methods of shot peening that have been developed, one making use of a centrifugal wheel revolving at a high speed to direct the shot onto the work, and the other employing a blast of compressed air. The first method, as carried out in Wheelabrators, built by the American Foundry Equipment Company, is the one discussed. Different types of machines are described, including one designed for shot peening airplane propeller blades, and other information is given regarding shot-peening operations. *Machinery*, April, 1945, pages 170–179, 12 illus.

Manufacturing the Hercules Piston. Part II. J. A. Oates. Concluding half of a two-part article relating the methods by which Specialloid Ltd. manufactures pistons for the 14-cylinder Bristol Hercules sleeve-valve engine. Part II is concerned with the latter stages of the machining process, the diamond-turning and boring operations, final inspection procedures, and laboratory control techniques. It also supplies additional information about the fettling and heat-treatment departments, briefly mentioned in the first installment. A table listing final operations in the fabrication of the piston is included with the text. *Aircraft Production*, April, 1945, pages 176–183, 22 illus.

Aircraft Pattern Making with Gypsum Cement. E. H. Schleede. The advantages of gypsum-cement plaster in the making of patterns and models are set forth. It is stated that the use of this material makes for speed and accuracy in production and that it is particularly adaptable to complex contours and intersections, permitting tolerances as small as 0.005 in. and being immune to temperature and humidity changes. The types and properties of gypsum cements developed for patterns are described. Information is provided about the various methods employed in making gypsum-cement patterns. The physical properties of gypsum cements are tabulated. Curves show the setting expansion of gypsum cement and the effect of consistency on the strength of casts. *Industrial Aviation*, April, 1945, pages 32, 34, 36, 38, 7 illus.

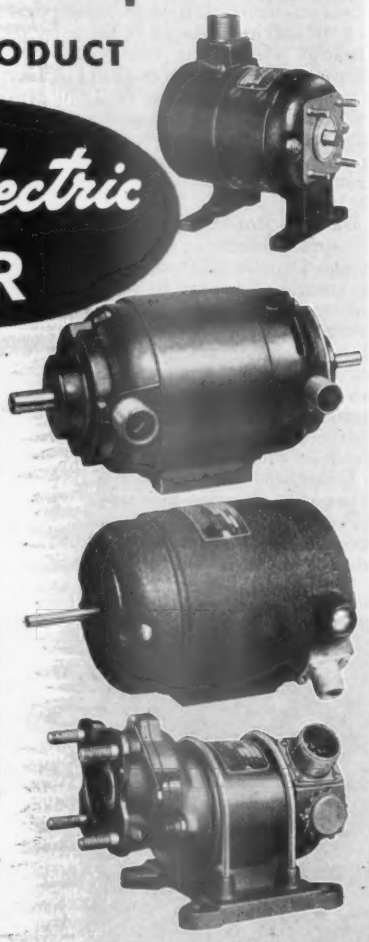
Chemistry of Surface Cleaning. Ray Sanders. A study is made of the basic chemical factors involved in the various processes of cleaning the surfaces of metals and other materials. The writer explains the chemical actions that take place during wetting, emulsification, and saponification, and defines colloidal activity and solvent action. He discusses the hydrogen concentration factor as a means for measuring the degree of alkalinity or acidity of water

Low Weight... Compactness

for your *New* PRODUCT

WITH A

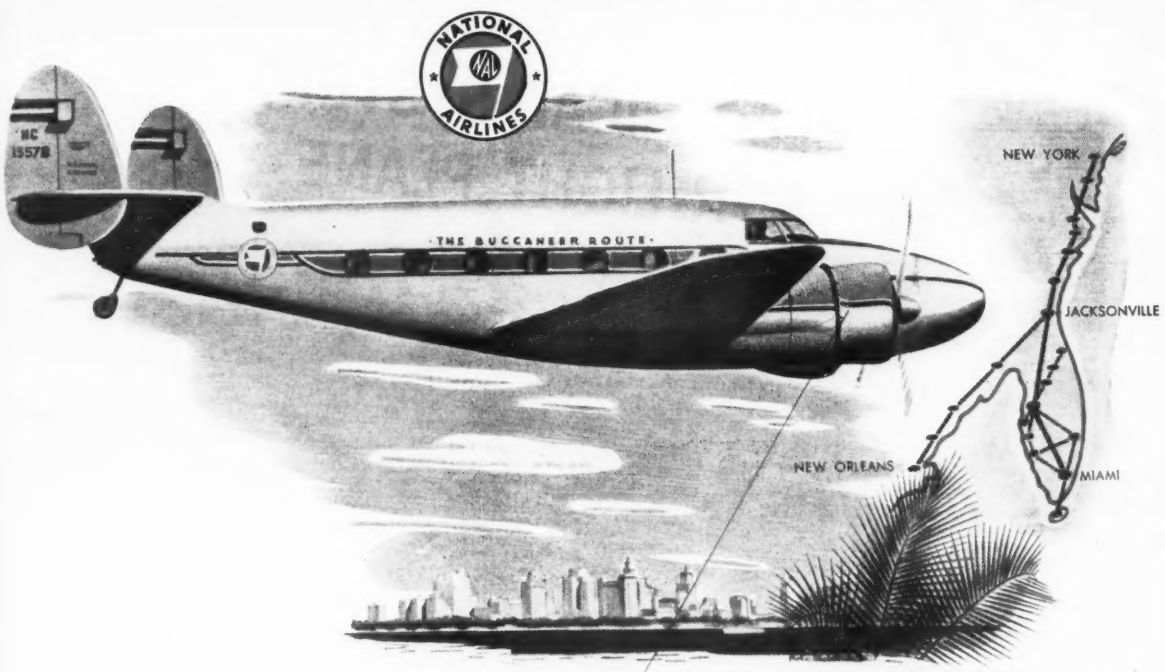
Lamb Electric MOTOR



30 YEARS' experience designing and building fractional horsepower motors for all types of special applications has taught us where and how much *motor* weight can be reduced without interfering with essential electrical characteristics. Our knowledge of products gained by close cooperation with many types of manufacturers frequently enables us to make design suggestions that reduce *product* weight, as well as improve compactness. It is best to discuss the motor while your products are in the *early stages* of development.

THE LAMB ELECTRIC COMPANY
Kent, Ohio

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS



FROM THE SKYWAYS OF THE WORLD . . .

BETTER SPARK PLUGS FOR YOUR PLANE

Champion Ceramic Aircraft Spark Plugs are used exclusively by National Airlines because "they are dependable, efficient and completely satisfactory." Operating its fleet of Lockheed Lodestars from New York through to the Southeastern Atlantic and Gulf states, National has compiled an enviable record for speed and service carrying vital war cargoes and priority passengers on unusually fast schedules. They strongly emphasize maintenance to insure dependability.

Thus once again the prestige and efficiency of Champion Spark Plugs for every aircraft engine is confirmed by their use by a leading airline—just as it has been so dramatically demonstrated in the most powerful bombers and combat planes. The Champions you buy for your present plane are products of the same research, basic materials, engineering and precision manufacture. Naturally they will insure an extra measure of performance, economy and dependability. Use Champions and fly with confidence. Champion Spark Plug Company, Toledo 1, Ohio.

DEPENDABLE

CHAMPION SPARK PLUGS

BUY BONDS — "BIGGER BONDS FOR THE MIGHTY SEVENTH"

For Sale

ELECTRICAL SYSTEM FOR LIGHT PLANE

Apply to **UNIONAIR**

FOR THREE REASONS:

1. The full engagement of Unionair's engineering and production facilities during the war in turning out electrical assemblies for aircraft has given its organization highly specialized knowledge in this field.

2. Unionair's insistence on its single responsibility in producing these units has created new high standards in quality.

3. Specialization has resulted in economies in production.

These three factors will also be applied by Unionair to production of complete electrical systems for light planes.

ARMY E NAVY

UNIONAIR

WRITE FOR NEW BOOKLET "ELECTRICAL ASSEMBLIES MADE TO CUSTOMERS' SPECIFICATIONS"

Electrical Assemblies — Hydraulic Fittings — Conduit Fittings — Junction Boxes

UNION AIRCRAFT PRODUCTS CORP., NEW YORK

solutions, and how that factor is determined. Reasons are given for the inclusion of a "buffering" agent in the formula for a detergent and the functions of the buffer are outlined. Although the article applies to all sorts of cleaning operations for the surfaces of industrial materials, it contains information useful to the aircraft industries with respect to cleaning aluminum and engine parts. *The Iron Age*, April 12, 1945, pages 62–67, 8 illus.

Ford Produces High-Speed Steel Cutters by Precision Casting. Charles O. Herb. This article describes the waste wax or investment method of mold making as applied to the precision casting of high-speed steel cutters at a plant of the Ford Motor Company. It is explained that it was the experience gained through the use of this process for the manufacture of precision-cast turbine rotor buckets which led to its adoption for the production of steel cutters. Consecutive steps in the manufacture of steel cutters are described and illustrated. *Machinery*, April, 1945, pages 144–151, 10 illus.

Modifying Superbombers on the Production Line. D. R. Abrams. An account of the procedures and methods by which Bell Aircraft Corporation processes modifications in the B-29 directly on the production line. This is accomplished by means of a system whereby a rapidly changing modification production control pattern is superimposed upon the regular production pattern. As described, a vital factor in this system was the establishment of an integral "Development Department" encompassing engineering (liaison), planning, scheduling, production control, dispatching, fabrication shop, and installation units. A diagrammatic layout illustrates how the design and engineering changes are incorporated during the production process. *Aviation*, April, 1945, pages 134–137, 6 illus.

Formed Sheet Metal Parts Classified by Shape. Part II. Mark P. Meinel. This is the second of a series of three articles dealing with the classification of formed sheet metal parts for aircraft. Critical design factors are listed for contoured flanged parts of nonuniform cross-section and for double curvature parts. *Product Engineering*, April, 1945, pages 241–244, 8 illus.

Car Production Principles as Applied to Aircraft. B. G. L. Jackman. A continuation of a short series on the utilization of the facilities of automobile manufacturers for the production of aircraft components discusses factory layout and equipment. Information is given about the building of a flight shed and final-assembly shop. Main assembly, subassembly, and detail assembly operations are discussed. Consideration is given to the equipment allocated to the different sections of the plant. It is concluded that something like 75 to 80 per cent of the equipment and floor space required for aircraft construction are possessed by the manufacturers who produce automobiles on a quantity basis. *Sheet Metal Industries*, April, 1945, pages 658–667, 12 illus.

Surface Finish. W. Ker Wilson. The second part of a paper read before the Institute of Mechanical Engineers, of England, is published for the information it contains relative to the application of surface-finish processes in the aircraft industry. It outlines the sources of surface weakness as poor geometric form, with sharp changes of section and corresponding areas of high stress concentration; fretting corrosion and wear, resulting in roughened surfaces and slackened fits; unfavorable residual stresses on which working loads are superimposed; scaling caused by poor heat resistance; poor surface finish; metallurgic defects; and mechanical damage. The effects of machining operations are mentioned and brief descriptions are given of the various processes by which surfaces are finished, these including case hardening, surface hardening, nitriding, cold rolling, shot peening, and plating. The writer then gives particular consideration to the use of these processes in aircraft-engine production. He discusses the causes of failure of crankshafts, valve springs, gears and threaded parts, and tells how remedies are applied by the use of the surface-finishing methods described. The article closes with remarks about the effects of surface finish. *Aircraft Production*, April, 1945, pages 189–193, 6 illus.

Shaved Aircraft Engine Gears. Charles G. Pfeffer. How gears for aircraft engines are processed with rotary-type shaving machines at the Paterson plant of the Wright Aeronautical Corporation is described. Reference is made to an investigation that was conducted to determine the possibilities of shaving various types of aircraft gears that previously had been ground. It was found that gears designed for finish grinding after hardening are equally well suited for shaving before hardening. The advantages to be gained by finish shaving and some of the precautions that must be observed are listed. It is stated that approximately 60 different gears now are being finish-shaved. Shaving is being done in production on some cluster and internal gears which, because of their shape, could not be ground. *The Iron Age*, April 12, 1945, pages 54–60, 14 illus.

Metallurgical Control of Shaved Aircraft Gears. R. E. Liebendorfer. The heat-treatment of shaved aircraft gears, as carried out at the Wright Aeronautical Corporation, is described, with particular emphasis on carburizing practice. Because the gear teeth are not touched after hardening, decarburization must be avoided during the hardening process. The writer describes radically new methods that have been devised to measure and control the amount of decarburization that may take place in thin surface layers. *The Iron Age*, April 19, 1945, pages 56–61, 9 illus.

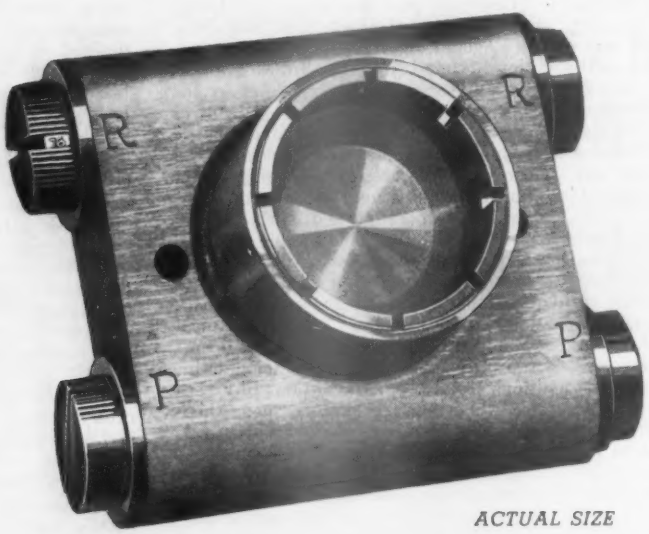
Trend in Aluminum Cleaning. Jay C. Harris. Alkaline, neutral, and acid media for the cleaning of aluminum are discussed. Abstracts of over 30 aluminum-cleaning patents are supplied. Available published matter on corrosion inhibitors is reviewed and agents suited to alkaline, neutral, acid, and corrosive salt solutions are tabulated. More than 20 cleaning specifications that deal directly with aluminum, or could potentially be used, are tabulated. Laboratory techniques for corrosion-testing and the evaluation of cleaning agents are discussed. *Aluminum and Magnesium*, April, 1945, pages 28–32.

Permanent Molds for Aluminum Piston Castings. Joseph Geschelin. Particulars are given about production operations at the Sterling Aluminum Products plant where 2,000,000 lbs. of aluminum-alloy permanent mold piston castings are being produced monthly. Information is furnished about the patented permanent mold equipment which, combined with advanced techniques, is stated to make possible the production of pistons possessing density of structure, freedom from porosity, fidelity of dimensions, and fine finish. Production equipment and operations are illustrated. One illustration shows how Lockheed brake pistons are rough-machined on Sundstrand stub lathes. *Automotive and Aviation Industries*, April 15, 1945, pages 30–32, 68, 70, 8 illus.

Propellers

Some Effects of Propeller Side Forces. G. A. Mokrzycki. A method is developed for the computation of the forces generated by the nonaxial flow of air through the propeller disc caused by yawing and pitching of the airplane, and the effects of those forces on the stability of the craft. Reference is made to the work of R. G. Harris in 1918 and H. Glauert in 1919, and to a method presented by L. B. Rumph, R. J. White, and H. R. Grummann, in a paper appearing in the JOURNAL OF THE AERONAUTICAL SCIENCES, for October, 1942, by which the propeller side forces are calculated. The writer applies the equations developed in that paper and in certain N.A.C.A. reports to the calculation of the effects of the propeller side force on static stability and on lateral and longitudinal dynamic stability, giving the mathematical steps in computing the forces arising from constant-speed and tractor and pusher types of propellers. *Aero Digest*, April 1, 1945, pages 94–97, 170, 8 illus.

Selecting Limba for Propeller Manufacture. In a paper delivered before the South African Branch of The Royal Aeronautical Society, a review is given of the processes employed in test-



ACTUAL SIZE

AIREX RELIEF VALVE

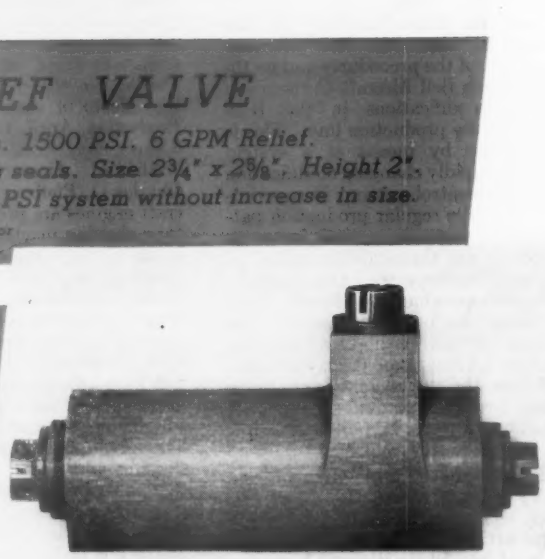
Designed to meet AN requirements. 1500 PSI. 6 GPM Relief. No coil springs, completely silent, no sliding seals. Size 2¾" x 2⅝". Height 2". Weight 10 ounces. Valve available for 3000 PSI system without increase in size.

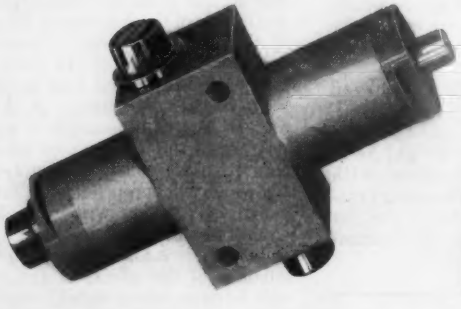
Patent applied for

AIREX RESERVOIR PRESSURIZING VALVE

For use on pressurized hydraulic reservoirs. This valve combines a filter, 2 check valves, and relief valve. Weight 5½ ounces.

Patent applied for





AIREX BRAKE VALVE

For use as an emergency means of applying variable air pressure to each of the wheel brakes.

Patent applied for

BUY MORE WAR BONDS

AIREX MANUFACTURING CO. INC.

LONG ISLAND CITY 1, N. Y.

Aircraft research & development — Hydraulic equipment

ing for aircraft propeller use the wood material called "limba," which comes from the Belgian Congo. Details are supplied about the hardness tests to which the wood is subjected, and this is followed by information about the selection of the wood in the forest and how it is prepared. *Wings* (Johannesburg, South Africa), December, 1944, pages 46–49, 7 illus.

New Mobile Devices Speed Prop Repairs. Details are given about a balancer and mobile workshop for the field repair and servicing of propellers. Both these units, products of Rotol, Ltd., are illustrated in the article. As described, the balancer consists basically of a central shaft with coned ends. This shaft is centered in the hub of the propeller, which is balanced while hanging by a vertical suspension link that terminates in a steel ball within the shaft. Any variation from the vertical results in a sidewise movement of the center indicator plate with regard to a scale plate beneath it. *Aviation*, April, 1945, page 154, 4 illus.

Self-Contained Automatic Mechanism of the Wickwire Propeller. Dimitry E. Olshevsky. Reference is made to the wide gap that has existed between the highly complicated governor-controlled, auxiliary power operated type of propeller for high-powered engines, and the simple fixed-pitch propeller. A description is given of the Wickwire automatic propeller which utilizes a relatively simple mechanism, with the sacrifice of only minor performance features. The operating principle of the propeller is explained. *Automotive and Aviation Industries*, April 15, 1945, pages 28, 29, 67, 68, 70, 3 illus.

A Novel and Economic Method of Increasing Flying Speed and Payload. A lengthy study describing the research and development work accomplished with reversible-pitch propellers by the Escher Wyss Engineering Works, Ltd., of Zurich, Switzerland, is contained in a special supplement. The principal advantages of the reversible-pitch propeller for deceleration are outlined, with particular reference to the improved wing loading made possible by the higher landing speeds permitted as a result of better braking. Economies are also possible in engine power and pay load for the same reasons. It is also shown that improvements in propeller design carried out by the firm have brought corresponding advantages in the take-off characteristics of current aircraft, without external take-off aids.

A detailed description is given of the improvements made by this firm in the automatic locking mechanism that prevents the inadvertent reversal of the pitch of the blades, and a new application of a pneumatic power accumulator in connection with the hydraulic mechanism for operating the pitch changes. Attention is directed to the speed with which the pitch angle can be reversed and returned to normal, this factor being claimed to eliminate the possible hazards of using the propeller as a braking device. The article is accompanied by charts and diagrams demonstrating the figures quoted. *Inter Avia*, No. 956-57 Supplement, January 20, 1945, 11 illus.

How Planetary Reducer Aids Compact Design. M. E. Cushman. An outline is given of the various functions that the controllable-pitch propeller must perform. Because of the necessity for extreme compactness and light weight, the design of the unit presents unusual problems. The writer discusses the more significant of these, with particular emphasis on the design of the planetary speed reducer employed in the Curtiss propeller. *Machine Design*, April, 1945, pages 135–140, 6 illus.

Design Progress on Junkers Hydraulic Propeller. John D. Waugh. A comprehensive engineering analysis of the Junkers controllable-pitch propeller. With details given on both the design and construction of the propeller and its various components, design changes that have marked the evolution of this German propeller from its origination in 1938 to its 1943 model are noted. Several cutaway drawings among the illustrations afford a view of the propeller's parts and those of its governor, and also demonstrate the relation of the individual parts to each other. *Aviation*, April, 1945, pages 117–123, 8 illus.

Radio

Suggested Standards for Private Aircraft Radio. Karl H. Stello. Specifications are outlined to show what qualities should be embodied in radio equipment to make it useful and efficient. Separate consideration is given to receivers, transmitters, tubes, antennas, power units, and mounting equipment. The importance of providing adequate instruction manuals with all instruments and good radio service facilities at airports is stressed. The article also contains some brief notes about frequency modulation equipment and installations that are likely to be standard equipment for the future. *Southern Flight*, April, 1945, pages 30–32, 68, 4 illus.

Reaction Propulsion

Rocket-Assisted Take-Off. C. B. Bailey-Watson. A description of the installations and methods employed for the rocket-assisted take-off of Fleet Air Arm carrier-based aircraft. The equipment examined is that of the Seafire, the Swordfish, and the Barracuda. *Flight*, March 8, 1945, pages 250–253, 10 illus.

Research

Aviation Laboratory Organizations Prewar and Postwar. Part IV. K. R. Jackman. Fourth article in a series analyzing the meanings, values, and problems of research as they relate to the aircraft industry. In Part IV the writer further considers the place of the research laboratory in an aircraft company, stressing the need for more organizational experience. He defines three general classifications of industrial aviation laboratories and describes the three forms in which research activities are now carried on. The points of view of various authorities on the subject are quoted throughout the article and a bibliography is appended. Organization charts of Lockheed Aircraft Corporation's setup for developing new aircraft illustrate several of the writer's points and the opinions that he relays. *Aviation*, April, 1945, pages 138–141, 6 illus.

Rotating Wing Aircraft

Rotor-Craft Speeds Are Due for a Doubling. Harold E. Lemont, Jr. The writer reviews the problems that have been solved in arriving at the present state of development in helicopters. He outlines the design compromises that were necessary and proceeds to a discussion of the problems involved in increasing the speed of rotating wing aircraft, with particular reference to rotor-tip speeds and vibration. Flapping and feathering rotors are compared, and the three types of rotating wing craft are described, these being the autogiro, the helicopter, and the helicogiro. The latter type is discussed in considerable detail, with descriptions and specifications of a proposed helicogiro scout craft and a helicogiro transport. It is predicted that a successful design for a high-speed craft of the helicogiro type will be produced in the next few years. *Aviation*, April, 1945, pages 129–133, 4 illus.

Helicopters Today. A compilation of photographs and drawings showing American-designed helicopters and autogiros in use now or intended for postwar manufacture. Brief descriptive details accompany each illustration. Rotary-wing aircraft developed by Platt-Le Page Aircraft Company, United Aircraft Corporation, Consolidated Vultee Aircraft Corporation, Bell Aircraft Corporation, Bendix Aviation Corporation, Aeronautical Products, Inc., Hiller Industries, Landgraf Helicopter Company, P-V Engineering Forum, and others are included in the compendium. *Skyways*, May, 1945, pages 44–57, 36 illus.

Stress Analysis

On the Solution of the Numerical Simultaneous Equations Arising in the Analysis of Redundant Structures. F. J. Turton. This article describes a simplified method of solving numerical simultaneous equations arising in the analysis of redundant structures through the application of strain energy, or slope-deflection methods. The method given reduces the solving of these equations to a column of successive evaluations, followed by the solution, by algebraic methods, of a small number of simultaneous equations; and a final column of evaluations. A number of problems are examined to show how the equations may be obtained in suitable sequence for the method to apply. Following an application to the determination of secondary stresses, the operations in-

Precision Workmanship + Engineering Know-How =CONTACT PERFORMANCE

THE constant factor in this equation is Mallory—known as Contact Headquarters by manufacturers of relays, industrial controls, business machines, domestic appliances, circuit breakers and other electrical and electronic equipment.

Precision workmanship at Mallory results from the experience which skilled men and women have gained in working with precious metals and special alloys. For instance, depending on the method most suitable for a specific assembly, they can torch, furnace, induction or resistance braze, silver solder, spot projection or flash weld, spin, rivet or stake contacts to supporting members.

Mallory engineers and metallurgists have 22 years of accumulated "know-how" in designing contacts and contact assemblies and in developing special materials such as Elkonium* and Elkonite*. They have created more than 5000 designs for individual contacts and complete assemblies.

Before your electrical or electronic equipment designs are blueprinted, consult Mallory engineers about contacts. Facilities are available for big production or small orders covering contact assemblies, individual contacts, or contacts joined to studs, springs, arms or brackets furnished by you.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

*Reg. U. S. Pat. Off. for electric contacting elements.

volved in the moment-distribution method and in this method are compared. A numerical example is worked out for a simple case and it is shown how any order of mathematical accuracy in the roots may be ensured, provided that sufficient figures have been retained to permit that accuracy. *The Journal of The Royal Aeronautical Society*, March, 1945, pages 104–111, 8 illus.

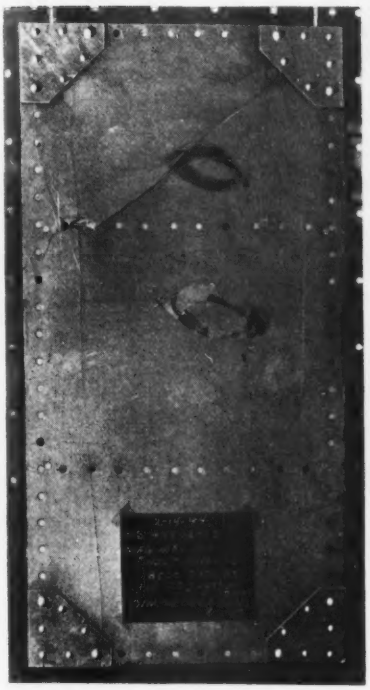
The Strength of Riveted Joints. I. G. Bowen. Reference is made to the method of analysis adopted in the Ministry of Aircraft Production Scientific and Technical Memorandum series of reports and data regarding the strength of typical aircraft rivets in joints of Alclad. The method results in tables of strength for different combinations of rivet, diameter, and plate thickness. Variation was provided for by the adoption of a reduction factor to the average strength figures. The writer examines the significance of these reductions and makes an exhaustive examination of the causes of variations, by means of statistical methods. *Aircraft Engineering*, March, 1945, pages 83–87, 1 illus.

Critical Loads in Thin-Walled Cylinders. Leon Beskin. This article is about the determination of critical buckling loads and margins of safety of thin-walled cylinders submitted to the combined effect of an axial load and a lateral external pressure. Charts are presented which can be applied to any combination of axial load and lateral pressure, a condition that occurs frequently in both aircraft and civil engineering. *Industrial Aviation*, April, 1945, pages 46–50, 99, 100, 6 illus.

Testing

Fatigue Failure in Shear Panels of Aluminum and Magnesium Alloys. E. R. Schenkel. Particulars are given about a series of tests instituted by the Consolidated Vultee Aircraft Corporation to establish data for the design of shear panels of adequate fatigue strength. A comparison was made of the shear-fatigue life of aluminum and magnesium-alloy panels fabricated with various types of rivets. The results of the tests are presented in chart form to allow the designer to evaluate quickly the fatigue characteristics of these rivet and alloy combinations in certain applications. *Product Engineering*, April, 1945, pages 222–225, 9 illus.

Adhesive Patch Method of Testing Aircraft Structures. E. H. Schwartz. A description is given of the adhesive or tension patch method for the structural testing of aircraft. It is explained that the method consists of (a) patches (tension or compression), made up of sponge rubber pads and base plates cemented together and to the surface of the test structure, (b) a leverage system, connecting the patches to hydraulic struts or jacks for applying tension or compression loads, and (c) a loading system, composed of hydraulic struts or jacks and operated by hydraulic pressure through control valves. The procedure for setting up a structure for test is described. Information is furnished about recent improvements in the method. It is stated that the adhesive patch method is used principally by the Air Technical Service Command for testing wing structures of large aircraft, canopies, windshield, radomes, doors, engine cowling, etc., where the proper distribution of loads is of primary importance. *Automotive and Aviation Industries*, April 15, 1945, pages 20–23, 90, 92, 94, 96, 8 illus.



A typical fatigue failure of 0.040-in. magnesium-alloy sheet indicates the type of failure resulting from cracks starting at the rivets. This is one of a series of tests made by the Consolidated Vultee Aircraft Corporation.

Testing Equipment

Tethered Flight Tunnel. Russell Lehmann. It is noted that flight at higher altitudes, greater aircraft speeds, new methods of propulsion, and radically different types of fuels have brought a demand for new and advanced methods of testing. Reference is made to activities of the Curtiss-Wright Corporation in the advancement of organized research which have culminated in a research program that is being carried out under the direction of Dr. C. C. Furnas. A detailed description is given of a proposed "aerodynamic testing sphere" that will make possible simulated flight tests under a wide range of altitudes and temperatures. This "tethered flight tunnel" consists of a hermetically sealed sphere; recording, testing, mixing, and visualizing instruments; and accurate control systems. It is explained that the interior installation consists of a shaft that is used as a vertical axle for a counterbalanced support or swing arm. The model is mounted at the outer end of this revolving arm. Illustrations show constructional details of this testing sphere. *Industrial Aviation*, April, 1945, pages 60, 61, 96–98, 2 illus.

Tools and Equipment

Cylinder Washing. Some brief details are given about the construction and operation of equipment for cleaning cylinder blocks on assembly lines. Manufactured by Curran Brothers, of Cardiff, this automatically operated machine is designed to remove oil, grease, sand, and swarf from the blocks. It is of all-welded construction and incorporates two sets of jet systems, one fixed and the other mobile. *Aircraft Production*, April, 1945, page 158, 2 illus.

Pneumatic - Electronic Sequence Control Developed for Flush Riveting Machine. A brief article describes how the overall efficiency of Model 2002 Erco riveters has been increased at Consolidated Vultee Aircraft Corporation by means of a pneumatic-electronic sequence control. Prior to the development of this unit, complicated flush riveting processes were manually controlled.

It is stated that electronic timing reduces errors caused by poor operator response or fatigue. A schematic diagram and illustrations of the timing device are shown. *Product Engineering*, April, 1945, pages 246, 247, 3 illus.

Five Shop-Method Improvements by Navy Mechanics. A survey of five devices that won awards in the Navy Employees Suggestion Program. The tools described are (1) a milling fixture for round stock which enables a number of pieces to be secured in place with the same motions that normally would be used for one; (2) a rubber block fastened to a rivet set, which compresses parts before heading the rivet, doing better work in less time; (3) a jack fitted with saddle top and angular wooden base, which enables the mechanic to install air scoops safely and without undue fatigue; (4) a two-part stud extractor that enables work to be done on terminal strips without removing them from position on the plane; (5) a tool for separating AN fittings from tubing "frozen" into them. *Aviation*, April, 1945 pages 149, 150, 6 illus.

Training

Graphic Demonstrations. E. C. Bailly. The value and effectiveness of instructing a pilot in a specific flight maneuver through actual demonstration of the maneuver by the instructor is discussed. Advice is given to the instructor on the procedures to be followed in using this "demonstration" method of instruction. *Air Facts*, May, 1945, pages 62–64, 66–68.

Transport Command Training. Parts I and II. A two-part article on the selection and training of air crews for the British Transport Command. After noting some of the diffi-

You will want this

HONEYWELL ENGINEERING FILE

The new Honeywell engineering file is especially designed to keep you abreast of the latest developments in aircraft control equipment. Made to fit all standard systems, this file is divided by fibre guides into nine distinct sections, each numbered and labeled with the names of control sytems now in the development stage. From time to time advance information bulletins, engineering data sheets, brochures, catalogs and test reports on the various equipment will be sent to owners of this file. This will enable you to maintain a complete up-to-date file on Honeywell control equipment for commercial aircraft. The supply of these files, however, is very limited. So write at once on your company's stationery, stating your title or position. If you qualify, one of the files will be sent you immediately, without cost or obligation. Write today to Aeronautical Division, Minneapolis-Honeywell Regulator Co., 2700 Fourth Avenue So., Minneapolis 8, Minnesota.

Send in your request today, on your letter-head, with your title or position.

MINNEAPOLIS Honeywell CONTROL SYSTEMS

CREATIVE ENGINEERING

MAKERS OF THE FAMOUS M-H ELECTRONIC AUTOPILOT, USED ON AAF 4-ENGINED BOMBERS

cult conditions under which the Transport Command must function and comparing it with the operation of civilian air lines, Part I outlines the syllabus of Transport Command Operational Training Units.

It describes the sources of personnel supply for Transport Command air crews; the requirements for T.C. operational training; the licenses accorded pilots, navigators, and wireless operators when they have graduated from an operational training unit; and the schedule of air-crew training handled by the O.T.U. It also contains information about aircraft and airdromes used for the flight instruction of Transport Command's operational training units; the stages of the flight instruction program; the introductory talks that pupils receive from various instructors when they first arrive at O.T.U.; and synthetic aids used in the training.

In the second half of the article, the training syllabus of the O.T.U. is described in detail. Particulars are given about the instruction courses in navigation, wireless, airmanship, and flight engineering. Various types of equipment for instruction purposes are noted, with attention especially called to the Link Trainers. Part II also tells of the activities and methods of the Ulster Express, an air line to northern Ireland operated by the O.T.U. It concludes with a summary of the general scope and value of the O.T.U. training. *The Aeroplane*, March 23, 1945, pages 344–347, 10 illus.; March 30, 1945, pages 373–375, 6 illus.

Visual Education in the Air Age. G. Patrick Meredith. Principles and applications of visual methods of training are discussed by the writer, who has studied visual training methods used in the Royal Air Force and the British aircraft industry. Consideration is given to the processes by which men learn to make and handle machines and by which they learn all the associated tasks, such as organization, navigation, meteorologic work, etc. Possible solutions to problems concerning the relationship between men and machines are suggested. *Aeronautics*, April, 1945, pages 28–32, 16 illus.

Paper Leadmen. This is an account of how the Douglas Aircraft Company made use of job-instruction booklets in the training of inexperienced employees for war-production schedules. It is stated that over a million and a half booklets on 60 subjects were issued. The technique employed in the creation and use of these booklets is described. Special visual methods of training were developed to meet different requirements. *Wings*, April, 1945, pages 1489–1491, 3 illus.

Warfare

3rd Phase of Jap Air War. Alexander Kiralfy. An analysis of the strategy and problems involved in what is called the "third phase of the air war against Japan"—the bombing of Japan from bases much nearer to her homeland. The island bases with which the discussion is mainly concerned are Okinawa in the Ryukyu Islands, Iwo Jima in the Volcano group, and units in the Kuriles and Bonin Islands. The point is emphasized that establishment by the Allies of air bases so close to Japan brings with it problems of defense not encountered in the European air war. On the other hand, it is explained that these islands are staging points and not main bases, and that their control means greater protection for Allied reserve areas, such as the Philippines, the Marianas, Fiji, the Aleutians, etc. *Flying Age*, May, 1945, pages 40, 41, 59–61, 5 illus.

Notes on the Vertical War. H. J. A. Wilson. Some curious technical innovations to which the struggle between aircraft and the submarine have given rise are described. The writer discusses this "vertical war," and describes some curious German devices for helping the submarines. *Aeronautics*, April, 1945, pages 48, 49, 5 illus.

Twenty Tips for Fighter Pilots. Lt. Malcolm Cagle. A series of 20 operational "do's" and "don't's" for pilots of fighter aircraft. The suggestions are reported to have been assembled from the experiences of U.S. Army, Navy, and Marine aces. *Air Facts*, May, 1945, pages 36–40.

Weight Control

Aircraft Design and the Weight Engineer. Paul A. Piper. The duties of the weight group in an aircraft engineering department are discussed. An outline is given of the activities of the weight group. Desirable educational qualifications for a beginner in the weight department are stated to be 2 years in an engineering college with preference for a graduate engineer, or equivalent engineering experience. Advantages to be gained by adhering to these educational requirements for new employees are listed. *Weight Engineering*, Spring, 1945, pages 11, 12, 40.

Simplifying Flying Boat Weighings. N. Farrar. A simplified method of weighing flying boats, adopted by the Rohr Aircraft Corporation, is described. This method permits the aircraft to be weighed in any attitude, and with proper measurements the horizontal center of gravity can be determined within reasonable tolerances. *Weight Engineering*, Spring, 1945, pages 42, 43, 4 illus.

Welding

Applications in Light Alloys. H. Sutton. This paper was read at a symposium on welding after the war, organized by the Institute of Welding (Ltd.), of London. It is noted that wartime requirements have caused a considerable extension in the utilization of welding as a method of construction. Progress in the welding of aluminum alloys is discussed. It is stated that the art of spot-welding aluminum alloys is advancing rapidly at present. The welding of magnesium-rich alloys is discussed. It is predicted that the knowledge gained in recent years will lead to the better use of welding after the war. *Transactions of the Institute of Welding*, February, 1945, pages 17, 18.

Gas and Heliarc Welding of Magnesium Alloys. F. E. Heatley. This paper describes tests conducted by Consolidated Vultee Aircraft Corporation to ascertain the differences in the efficiency of oxyacetylene and Heliarc welding on sheet magnesium for the various types of currently available sheet. The results of the tests are stated to indicate a higher percentage of efficiency for the Heliarc method. Tables give comparative figures for the welding efficiency under different conditions, and other data. *The Iron Age*, May 3, 1945, pages 64–66.

Welding Insures Leak-Proof Seams in P-38 Drop Tanks. An account is given of the consecutive steps in the production of drop tanks for fighter aircraft at the Los Angeles plant of the Weber Showcase Company. It is noted that two of these 165-gal. tanks give the Lightning a ferrying range of 2,200 miles. Welding is used extensively in the manufacture of these drop tanks and a considerable portion of the article is devoted to welding operations. After the vertical bulkheads are welded into the half-shell, the two halves of the tank are seam-welded together. Welding techniques and the fixtures used are described. A high production rate is achieved by coordinating stationary and moving production lines. *Steel Processing*, April, 1945, pages 240, 241, 261, 262, 6 illus.

Silver Brazing in Aircraft Production. J. P. Weed. The writer discusses the use of silver brazing in the fabrication of the smaller aircraft-component assemblies. It is noted that in this field silver brazing is replacing gas and arc welding because employees require less skill and training to carry out the work. The various methods of silver brazing are reviewed. Factors making for sound assemblies are discussed. *The Iron Age*, May 3, 1945, pages 56–60, 8 illus.

The Welding of Non-Ferrous Metals. E. G. West. This is a continuation of an article devoted to welding procedures as applied to the various nonferrous metals and alloys. The metallurgic properties of nonferrous metals, which govern to a large extent the choice of the welding process, are discussed. Sections deal with wrought products, heat-treated alloys, the effect of heat on the parent metal, the combustion of hydrogen and oxygen, and the control of the welding flame. The essential requirements of oxyacetylene apparatus are also discussed in sections devoted to gas supply, blowpipes, and

No Shimmying for the BLACK WIDOW

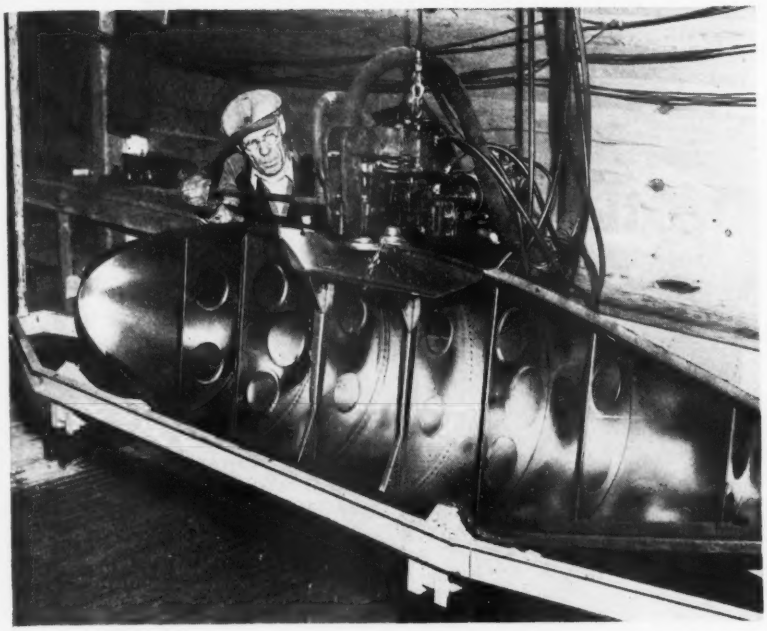
Twelve tons and more of fighting might, the Northrop Black Widow P-61 night fighter can take off steeply and swiftly—and can land at amazingly low speeds—on small airports in complete darkness.

All-important during such take-offs and landings is the shimmy-free operation of the nose wheel. It is controlled by the Houdaille* Hydraulic Shimmy Damper which absorbs shimmying forces, no matter how violent, on America's foremost fighters, bombers and cargo planes.

Houdaille engineering experience goes back to aviation's earliest years and is available for the industry's plans for the future.

HOUDE ENGINEERING DIVISION OF
HOUDAILLE-HERSHEY CORPORATION
MAKERS OF HYDRAULIC CONTROLS
BUFFALO 11, NEW YORK

*Pronounced—Hoo-dye



A pan is seam-welded into a drop tank for a fighter aircraft at the Los Angeles Plant of the Weber Showcase & Fixture Company, Inc. This method produces leakproof seams, essential for the gasoline-carrying tank.

regulators. *Sheet Metal Industries*, March, 1945, pages 509–513, 12 illus.; April, 1945, pages 694–698, 4 illus.

Spot Welding of Magnesium Alloys. Kenneth E. Dorcas and N. H. Simpson. This two-part article discusses spot-welding applications in the fabrication of magnesium-alloy aircraft parts. Part I describes experiments conducted by Consolidated Vultee Aircraft Corporation to determine whether existing stored-energy type welding equipment would produce strong and uniform welds. Optimum machine settings were worked out for various gages of magnesium alloys.

Part II describes tests of cleaning agents which finally led to the development of a cleaner that was found to be comparable in its effects to wire brushing, according to readings on a surface-resistance meter. Information is also given about the relative effectiveness of chemical protective finishes applied after spot welding. *The Iron Age*, April 5, 1945, pages 50–53, 10 illus.; April 12, 1945, pages 68–73, 9 illus.

The Pickling of Alclad D.T.D. 390 and Duralumin B.S.S. 5L3 Prior to Spot Welding. R. F. Tylecote and R. W. Pittaway. It is noted that in Great Britain the process used for the pickling of light alloys prior to welding is based on reducing the resistance caused by the oxide film present on the surface of the sheets in contact with the electrodes. Reference is made to the work of Hess, Wyant, and their coworkers in the United States, which has shown the advantages of a process based on the reduction of the contact resistance between the sheets. In this report it is shown that these advantages will also be obtained with British materials from various manufacturers. The investigation was concerned with the effects of various pickling solutions and the methods of wetting and drying, the results of which are given in the text, tables, and curves. *The Institute of Welding Transactions*, November, 1944, pages 129–136, 23 illus.

Spot Welding of Aluminized Steel. Harry W. Brown. The results of research carried out to determine the spot-welding characteristics of 0.0375-in. aluminized steel are summarized. The work was done at the University of Texas as part of the writer's thesis in aeronautical engineering. Sections of the article discuss the effect of electrode-tip shape, the effect of surface cleaning, the characteristics of the welds, the effects of tip pressure and weld time, and the life of the tip. It is concluded that shear strengths averaging 1,800 lbs. and higher can be consistently obtained with a tip pressure of 700 lbs. and current of 18,000 amp., using electrodes of 2-in. dome radius. *The Iron Age*, April 26, 1945, pages 56–62, 17 illus.

Miscellaneous

Western Flying's 17th Annual Directory Number is divided into six sections. The first is a compilation of released data on American military aircraft, showing photographs and three-view drawings of the various aircraft. The second contains illustrations of, and information about, civil airplanes planned for early postwar production. Specifications and performance data on civil aircraft that are out of production but still in service are listed in a set of tables which compose the third section. In the fourth section, specifications and photographs of engines produced by all American manufacturers are given. A directory of manufacturers in the fifth section includes the names of key administrative, engineering, and production personnel of aircraft, engine, and propeller companies. The last section lists U.S. air lines and their key personnel. *Western Flying*, April, 1945, pages 70–200, 206 illus.

Annual Review of Military Aircraft. This annual directory is divided into five sections. The first contains two tables, one of Canadian and U.S. military airplane specifications, the other of British military aircraft specifications. The second section consists of photographs and descriptive data on Canadian, British, and American military airplanes; the third shows Canadian, British, and American noncombat planes. A compendium of German warplanes comprises the fourth section and Japanese military types the fifth. In many cases identification drawings supplement the photographs of the aircraft. *Canadian Aviation*, April, 1945, pages 77–130, 230 illus.

Aircraft Electrical Equipment

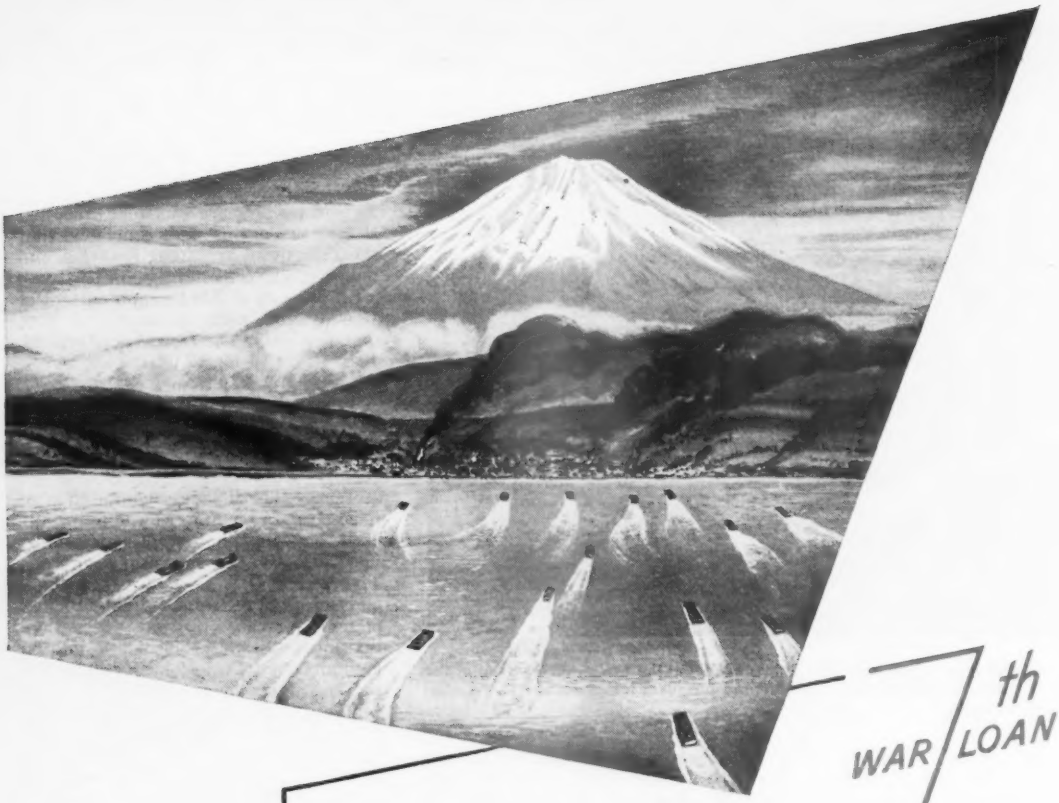
(*Continued from page 41*)

tively effective but heavy solution is found.

The current trend is toward a coupling, hydraulic or mechanical, which will serve as a constant power (with variable torque and speed) connection between the constant-speed motor and the driven device. As an example of this trend a $^1/_{10}$-hp. servomotor has been developed weighing little more than 7 lbs. This uses a mechanical coupling.

Controls

The field of controls, particularly automatic, offers a great field for the electrical engineer. Automatic controls lead to a more efficient airplane and one that is easier to operate. For example, it is possible to control all of the variables in engine control, throttle, boost, speed, and mixture with one lever. Further, one lever can control all engines at once. This control can be along the best parameters of performance at any altitude, power, and speed. Another example is automatic temperature controls. Any of these will add to the ground maintenance problem, but this is not serious when it is anticipated. In the meantime, the operation of the airplane has been made easier. Further, the added weight of the automatic controls is more than compensated by the saving in fuel. In fact, this saving alone is sufficient to buy another airplane long before the first is worn out.



7th WAR LOAN

We've just begun to fight

Our fighting men have accomplished miracles in the Pacific. Maybe that's led you to believe that Japan is a pushover. Think again. We still have to meet and crush the main body of the Japanese Army *inside the inner Empire.* To do this, we've got to move millions of fighting men—*freshly outfitted and equipped*—halfway around the globe! And *keep* them supplied over vast stretches of water. More of everything will be needed.

This is going to call for more money than your mind can grasp. Money that *has* to come from you. Not later, but *now*—during the 7th War Loan Drive. It'll take the larger part of a month's salary from most of us to meet the quota—*in addition* to the Bonds we're buying regularly. You *can* buy bigger extra bonds just as the Marines found a way to take Iwo Jima. *They* paid in coin they'll never get back. *You* get *yours* back with interest!

Aireon MANUFACTURING CORPORATION

Formerly *AIRCRAFT ACCESSORIES CORPORATION*

Radio and Electronics • Engineered Power Controls

NEW YORK • • CHICAGO • • KANSAS CITY • • BURBANK

Government Publications

Army Air Forces

Data on Planes Used by Army Air Forces. Currently available data referring to most of the aircraft models now in use by the Army Air Forces have been released by the War Department. Descriptions are given concerning the dimensions, power plants, performance, bomb loads, armament, and protection of each type of airplane. Performance figures pertain to normal operations. Information is assembled under headings as nearly uniform as possible and the types are classified in groups comprising very heavy bombers, heavy bombers, medium bombers, light bombers, fighters, cargo transports, utility-cargo aircraft, gliders, liaison planes, helicopters, and photographic and reconnaissance aircraft. *War Department, Bureau of Public Relations.*

Pursuit Curve Demonstrator. A brief description is given of a device used in training fighter pilots and bomber gunners. It was developed by the Training Aids Division of the Office of the Assistant Chief of Air Staff, Training, and the Air Technical Service Command. Officially known as the Trainer, Demonstrator, Type Q-10 (Fighter Approach), the apparatus consists of ten model fighters and one model bomber, each moved manually along ribbon-like individual patterns to illustrate various types of pursuit curve attacks for the fighter intercepting a bomber flying a straight and level course. These include high side approach, left and right; level side approach, left and right; low side approach, left and right; overhead approach, left, right, and half-roll; low frontal approach. The device is employed also in training gunners in the types of attack to expect and the relationship of bomber and fighter during aerial combat. *Air Force*, April, 1945.

B-29 Modified to Serve as Photo Plane. Designed by the Air Technical Service Command in conjunction with Boeing Aircraft Company and the Fairchild Camera and Instrument Corporation, the Superfortress photo plane, designated the F-13A, is reported to be in operation. It can deliver almost as great a weight of bombs as the B-29, and matches the B-29's range and speed. It can map considerable areas in a single flight by the use of its battery of six cameras.

For photomapping territory, the F-13A has a trimetrogon comprising three K-17 cameras mounted side by side, one pointed straight down and the others flanking it, pointed toward the horizons. The trimetrogon films a strip 20 to 30 miles wide, depending on the altitude at which the plane is flying. For highly detailed reconnaissance and photo-interpretation work, the plane carries two K-22 cameras in a split vertical mount. These cameras photograph particular targets, such as railroad yards, harbor facilities, gun installations, and industrial plants. In contrast to the trimetrogon, the area covered by split vertical cameras at 20,000 ft. is only about 2 miles wide.

The sixth camera is a K-18, with an assignment similar to that of the split vertical pair but covering a wider range and taking a larger negative. It is used for close-ups of specific areas mapped by the trimetrogon and for photographing target areas that do not require the pin-point detail of the split vertical. The craft can also be equipped with a K-19, a special camera designed for night photography.

On a routine mission, the F-13A can take more than 5,000 separate exposures. It employs a complete combat crew of eleven, and a photographer and cameraman as well. *Air Technical Service Command.*

Physiology of Flight. A manual of 94 pages reviews the present state of knowledge of some of the more important physiologic problems in aviation with particular reference to military air operations. It outlines the limits imposed by the structure of the human body and the mechanical aids that have been devised to combat these physiologic limitations.

The chapters give detailed information about the physical characteristics of the atmosphere, the effects of altitude upon the respiration, vision, and circulation systems, the effects of low pressure, ascent, descent, cold, and acceleration. Other chapters contain descriptions of oxygen equipment, pressure cabins, emergency escape devices, noxious gases, and evacuation of the sick and wounded by air. This manual replaces a manual of the same title published in 1942 by Aero Medical Laboratory, Engineering Division, Air Technical Service Command. *AAF Manual No. 25-2*, March 15, 1945.

Flying the Zeke 52. Herbert Ringold. An evaluation of the flight characteristics of the Zeke 52, from opinions of American test pilots who have flown it. The summarizing conclusion is that, since the 52 is a very light airplane with a good engine, the opposing pilot should not try to turn with it at low altitudes, dogfight it, or follow it in a shallow loop. *Air Force*, April, 1945.

Timer for High Speed Photos. An electronic sequence timer, permitting six photographs of a 0.50-cal. bullet while it moves half its own length, has been developed by photographic engineers of the Air Technical Service Command. Originally conceived as a means of studying the effects of gunfire on armor plating, the timer synchronizes six microflash lamps so they may be fired either in train or simultaneously. The outfit now is being used to study the rupturing of propeller blades but after the war it may be used by industry for time-motion studies of high-speed subjects.

The timer utilizes linear charging of a condenser through a pentode tube, a use of a sweep circuit adapted from television. Linear charging produces a constant rate of voltage increase, and this voltage, rising across the condenser, is applied to six amplifiers that are set for progressively decreased sensitivity. As the rising voltage trips the amplifier with the greatest sensitivity first, the lamp to which it is connected is fired.

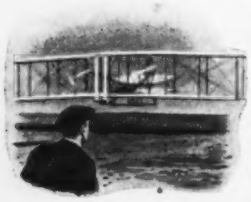
Linear charging also enables timing of the pictures exactly, for by turning simple dials the operator can space the six lamps so that it takes $^{6}/_{10}$ sec. for all six pictures, the slowest rate, or as little as $^{3}/_{10,000}$ sec. at highest speed.

The photographic engineering branch of the A.T.S.C. engineering division's technical data laboratory received six of the first microflash lamps ever built about a year ago. They were a development of Dr. Harold E. Edgerton, Professor of Electrical Engineering at Massachusetts Institute of Technology and a laboratory consultant. By conservative measurement, each lamp flashes in approximately $^{2}/_{1,000,000}$ sec. Built originally for work with small, high-speed parts at ranges of 6 to 8 ft., the range of such lamps has been increased to 40 to 50 ft. The equipment used with the lamps includes X-ray film, an *f*/25 night aerial camera lens, and a concentrated developer.

Microflash pictures are taken by opening the camera shutter in darkness, flashing the lamps and closing the shutter. The lamps may be actuated either by sounds that react in microphones; by electrical impulse transmitted by electrical circuits, such as in propeller-rupture studies where the ex-

This advertisement is one of a series now appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of how and why America must retain its present Air Supremacy, even after Victory.

LET'S KEEP AMERICA STRONG



America invented the airplane . . .

. . . and yet the most disastrous defeat we ever suffered in our entire history was when Japan attacked us at Pearl Harbor . . . *with our own invention.*

The truth of the matter is this: Having invented the plane, we were content to remain a second-rate power in the air . . . and we were caught napping.

Who will save us next time?

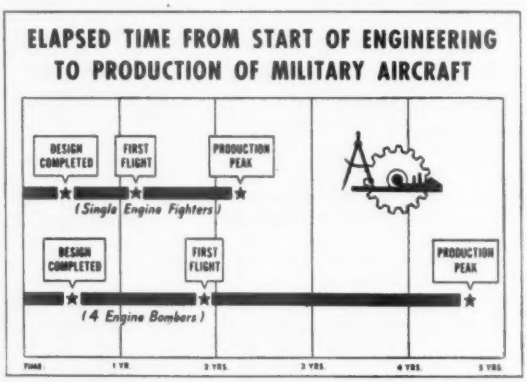
Germany spent 10 years building up her Luftwaffe — then she struck.

Hitler used 3000 planes in a single campaign—the cowardly conquest of Poland. **Yet, even later, when Japan pulled her sneak attack, America had a total of only 1157 planes fit for combat.**

All this time, America had no well-defined air program. We had to start almost from scratch, frantically building up strength in the air while Britain held off the enemy.

Time—the Joker in Air Power

We learned that it takes time to develop a military plane. It took 7 years to produce America's first long-range heavy bomber—and 3 years to produce the Liberator bomber in quantities, even though Consolidated Vultee had years of experience building mammoth sea planes.



More by good luck than our people's foresight, a new fighter plane, designed in 1936, started coming off the production lines in 1941. And another fighter was almost ready for mass production at the time of Pearl Harbor.

Today—only at a terrific and needless cost in money and lives—we are finally strong in the air. Stronger than any other nation on the face of the globe.

Air Power for War . . . and Peace

After Victory is won, if we forget some of the lessons we have learned so painfully in this war, we can easily drift back again to the status of a second-rate power in the air.

Dare we rely on such a hit-or-miss air program next time?

IN THE AIR!

America cannot hope to remain strong among the nations of the earth unless Air Power is maintained during peace years as well as when at war.

No one denies that to maintain American air supremacy, our military planes must excel those of any other nation.

But military air strength is only one important phase of Air Power . . .

The necessity for waging war on a global scale has opened our eyes to the role which air transport has played in supplying our fighting fronts, from China to the Rhine.

Tomorrow, huge transport planes—***an American Merchant Fleet of the Air***—will open up new areas of natural resources, and help bring about a mutual appreciation of peoples in once-remote lands. **The plane will be an important factor in promoting a relationship under which nations can live together peacefully.**

A Nation on Wings

Since the turn of the century, America has been a "nation on wheels." Even more important, the automobile made us a mechanically minded nation. And this was a good thing, when war came.

For, the mechanical knowledge gained from tinkering with a $10 jalopy has made untold thousands of American boys the world's finest airplane pilots and mechanics.

Now, overnight, we have become a "nation on wings." The Air Age is here. When the war is finally over, many thousands of people in this country will take to the air—in their own small personal planes.

Today, a 60-Hour-Wide World

A nation which thinks and works in terms of Air Power has taken a long first step toward insuring a lasting peace—for air strength is a force which aggressor nations fear and respect.

Today, under the impetus of war, the aircraft industry has become five times bigger than America's vast prewar auto-

mobile industry. It is turning out planes at the rate of over 6000 a month.

Our aircraft industry must remain strong, and competitive. And it must constantly work in research and technological advance, even after Victory.

And finally, we must teach our children—and we ourselves must never forget—that the world is now one global community in which *no spot on earth is more than 60 hours' flying time from our local airport.*

Millions of air-minded young Americans, who will soon be returning from overseas, know that this is why we must keep America strong in the air!

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif. Vultee Field, Calif. Fairfield, Calif. Tucson, Ariz. Fort Worth, Texas New Orleans, La. Nashville, Tenn. Louisville, Ky. Wayne, Mich. Dearborn, Mich. Allentown, Pa. Elizabeth City, N. C. Miami, Fla.

Member, Aircraft War Production Council

LIBERATOR, 4-engine bomber · LIBERATOR EXPRESS, transport · CORONADO, patrol bomber · PRIVATEER, search plane · CONVAIR MODEL 37, Pan American Clipper · CATALINA, patrol bomber · VALIANT, basic trainer · SENTINEL, "Flying Jeep"

Two summers ago he was chasin' down cattle on a Texas ranch.

Now, in a truck he calls "Busy Lizzie," he hauls high-octane aviation gasoline round a jungle airfield. He's a key-man who knows every plane, pilot and crew-chief on the field.

All through the day and into the night he and his truck make their rounds, gassing up. And last thing, in the blackout of a jungle night, you can see the sparks his tail chain makes, dangling from the back of the truck, as it rattles across the steel-matted runway—still on the job.

Remember this cowboy and his truck of gasoline when you hear that American planes have destroyed yet another enemy target.

And remember him and the millions of his comrades *after* the war—men who have made *air travel, air cargo, air express* the business of their daily lives. And who will come home to make them safely, wonderfully and *surprisingly quickly* part of the daily life of their country.

Cowboy in a Cab...headed for tomorrow

EVER SINCE WE FUELED THE WRIGHT PLANE *at Kitty Hawk, we have been air-minded... By 1937, 87 out of the 91 successful trans-Atlantic flights had used our gasoline. To date we have produced the super fuels to power one out of every four U. S. and British combat planes. Such is our back-log of experience. Out of it, and out of research in the largest laboratories in the industry, our promise for the future is simply the development of the finest possible aviation fuels and lubricants. "You can* depend *on Esso Aviation Products."*

act moment of rupture cannot be predetermined; or by light reacting on a photoelectric eye. *Air Technical Service Command.*

All the Answers. Major Robert V. Guelich. An account is given of the functions and operating methods of the U.S. Army Air Forces Proving Ground Command. It is related how this Command proof-tests A.A.F. weapons and tactics on simulated missions, developing new flight and combat techniques. *Air Force*, April, 1945.

California State Department of Education

Aviation Education in California Public Schools. This report of the California aviation education conference, held at Berkeley in May, 1944, includes recommendations for schools contemplating the addition of aviation education to their curriculums. Its findings and recommendations are divided into three categories, the first dealing with aviation education in the elementary schools; the second, in high schools; and the third, in junior colleges. There are also several appendixes, the first of which is an index of the location and class of California airports, and the type of instruction available prior to 1943. The second appendix consists of a bibliography for high school courses in aeronautical science; and the third lists motion pictures and film strips which are available for instruction in various phases of aviation. *Bulletin of the California State Department of Education*, September, 1944.

Civil Aeronautics Administration

Glossary of Aeronautical Terms, English-Spanish (Preliminary Draft). This glossary was prepared primarily for use in connection with the Civil Aeronautics Administration manuals and other material now being translated for use in Spanish-speaking countries. It is also intended to assist in the standardization of Spanish translations of English aeronautical terms. *Civil Aeronautics Administration*, Office of Information and Statistics, August, 1944.

Application of Transport Category Operating Rules. Primarily because of the war, the application of the transport-category operating rules, affecting aircraft used in scheduled operation carrying passengers, has been postponed, with a single exception, with the result that almost no experience has been obtained about their operation. For that reason and in anticipation of the general application of these rules in the foreseeable future, this study has been undertaken to determine the nature of the problems involved in applying them. The purpose of this report is to illustrate as well as possible by means of the method adopted, certain aspects of the transport-category operating rules. It gives a discussion and an example of the application of the rules to an actual airplane that has been the subject of extensive operating experience, and to a route over which that airplane has been flown in scheduled operation. The aspects of the rules to which the discussion is applied are as follows: (1) The nature of the rules themselves; (2) the type, extent, and possible source of the basic information which is required in order that they be applied; (3) the various problems involved in, and the process by means of which, this information is applied to an analysis of a route, its airports, and the airplane to be operated over it, to determine the conditions under which the operation must take place; (4) possible forms in which to present the analysis for the purpose of showing the proposed operation to be in compliance with these operating rules; (5) the nature and extent of the information required for the process of dispatching under these rules; (6) the possible gain in the weight of the airplane which is permitted under these rules resulting from taking advantage of certain refinements that the rules themselves permit. The principal one of these so permitted is an allowance that 50 per cent of any head wind component may be considered in determining the maximum take-off weight upon a runway of given length.

For the purpose of this report the route from Chicago to Salt Lake City has been selected, primarily because it contains terrain and airports of altitudes such as very nearly cover the extreme ranges of altitude to be encountered anywhere within the continental limits of the United States.

After an introduction explaining the purposes and limitations of the report and the conditions surrounding the study, the report is divided into main sections dealing with the basic information required, the method of analysis, the application to the route selected, and concluding remarks. In addition to the text matter, the booklet contains numerous diagrams and graphs relating to the route and the airports located along it. It is noted that while the report may be appropriate material from which to draw general conclusions concerning the nature of the transport-category operating rules, it is by no means a definitive treatment of the rules but rather merely an illustrative example of their application to a particular airplane and route. *Flight Engineering Report No. 14, October 31, 1944, Flight Engineering and Factory Inspection Division.*

A General Flight Test Program for the Transport Category. A booklet of 133 pages contains a program itemizing all of the testing believed likely to be required for certification of aircraft in the transport category. The program was devised to provide means by which, systematically and in proper order, all items involved in the type-certification process may be considered, bringing to bear upon each all of the available information and deciding what will be required for each, in order to arrive at a statement of the complete test program that must be undertaken for a particular airplane. The basic function of a flight plan is to identify the tests to be conducted during the flight, the order in which these are to be performed, and, for each, to describe briefly what is required of each member of the flight-test crew.

Twelve flight-test plans are given in detail, retaining as much flexibility as possible so that they may serve the wide range of use for which they are intended. The sequence of the twelve plans has been chosen primarily by the order in which the required tests must be conducted, and the sequence of tests within an individual flight plan has been dictated primarily by convenience and efficiency in the use of the flight time. The program is outlined in a tabulation of 62 items under 15 headings.

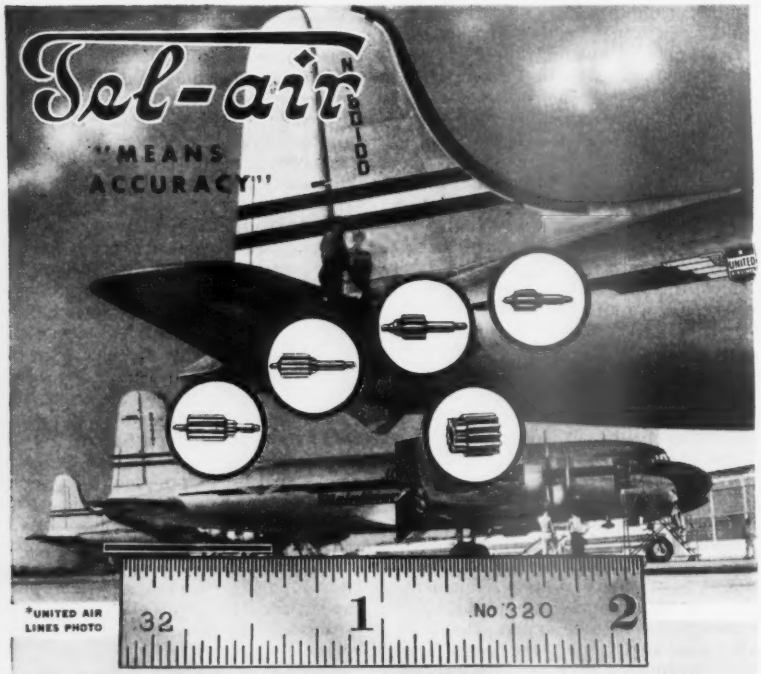
It is not anticipated that the complete flight-test program and set of flight plans presented in the report will be found applicable in their entirety to any airplane. They are regarded rather as an outline of all the probable testing that might be required for any airplane and as a tool by means of which to arrive at a particular program and set of flight plans for a particular airplane. The process by which they may be used for that purpose is discussed in full. *Flight Engineering Report No. 15, December 1, 1944, Flight Engineering and Factory Inspection Division.*

Treading of Aircraft Tires. Experience gained during the last 2 years in the work of treading tires has resulted in the modification of the Administration's policy regarding the treading of tires for air-carrier use. The original policy of requiring that tires used on air-carrier aircraft be returned to the factory of original manufacture for treading was modified about a year ago to permit tire manufacturers or their representatives to tread tires made by another manufacturer. This procedure was found to be satisfactory and proved to be helpful in a number of cases, as it allowed repair depots established by some of the tire manufacturers to tread various makes of tires. Transportation space was thus saved, as well as shipping charges, and the tires were returned to use much sooner.

Since there are very few such repair depots established, many operators have had to continue returning tires to Akron. Therefore, the question has come up regarding the eligibility of local, privately owned, treading agencies to do this work. Experience now gained by a number of such agencies indicates that they are fully capable of treading tires for air-carrier use. Many of them have been treading tires for nonair-carrier aircraft for some time and have attained sufficient equipment and experience in this work so that both the Air Carrier and Aircraft Engineering Divisions now feel that the treading policy may be safely expanded.

Accordingly, air-carrier aircraft tires may be treaded by any local agency provided that:

(1) An inspection is first made by a representative of the Administration to



Another Tel-Air Part
Small Tel-Air gears showing comparative size

THE BIG JOB *of the* TINY GEAR

Rule shows how small these little pinions are—yet tiny gears like these have a vital part in the success of a giant machine's operation.

ABSOLUTELY UNIFORM PRECISION, tolerance, and concentricity in every machining and finishing operation—these are essential factors, the perfection of which spells Tel-air ACCURACY.

Bomb Fuzes, in which the pinions illustrated are used, and hundreds of other intricate component parts bear witness to the dependability of Tel-air precision engineering.

Right now ALL Tel-air production is devoted to the final push to end the war as soon as possible.

Buy more War Bonds NOW!

* Planes illustrated are the 4-engine type which United has ordered for post-war service.

In the Air it's Tel-air

On the Highway it's Teleoptic

THE TELEOPTIC CO.
1255 MOUND AVENUE RACINE, WISCONSIN

make sure that the agency has adequate equipment for treading airplane tires; that the workmanship is satisfactory; and that sufficient trained personnel is employed. (Probably many such agencies will have had experience treading tires for the Services hence they will have done work in accordance with Army-Navy Aeronautical Specification AN-C-82 for the repair and retreading of tires and AN-R-18 pertaining to repair and treading materials.) Once this inspection is made to establish the fact that the agency is qualified to tread aircraft tires satisfactorily, no other inspection is necessary although an inspector may occasionally call on the agency.

(2) The name of the tire manufacturer is buffed off the sidewall of the treaded tire, since the original manufacturer will no longer be responsible for the tire.

(3) A statement is submitted in duplicate through the inspector to the Aircraft Engineering Branch describing the treading process employed, the grade of materials used, and to what extent the old rubber is removed from the tread and whether or not new rubber is put on the sidewalls down to the bead. This statement need be submitted only once, either at the time of the initial inspection of the agency's facilities or as soon thereafter as possible.

The policy regarding the use of treaded tires on nonair-carrier aircraft remains as it has been for some time; that is, owners may have their aircraft tires treaded by any local tire treading facility. As mentioned in item 2, the tire manufacturer would prefer to have his name buffed off the tire. *Safety Regulation Release No. 171, Air Carrier and Aircraft Engineering Divisions*, February, 1945.

Civil Aeronautics Board

Changes in Civil Air Regulations. The Civil Aeronautics Board has announced the culmination of 18 months of intensive effort by the staff of its Safety Bureau in the adoption of the revised Parts 20 and 60 of the Civil Air Regulations and the new Parts 43 and 49. The adoption of these parts, which will become effective July 1, 1945, represents the completion of the first step in the plan announced by the Board months ago for the modernization of all the Civil Air Regulations, particularly those affecting the private pilot.

Among the significant changes in Part 20, Pilot Certificates, are the reduction in minimum age limits for a private pilot to 17 years, a reduction in the flying time required, and the elimination of navigation and meteorology in the written examination. While the minimum dual instruction required for a private pilot certificate has been raised from 8 to 10 hours, the determination of when the student is ready for first solo has been made the responsibility of the instructor. Of considerable interest to glider pilots will be the provision for appropriate credit for glider time toward a powered-aircraft rating.

ONE-MAN BOMBERS

Lockheed P-38 Lightnings—powered by Allison engines and originally designed as fighter planes—are now being used also as one-man bombers against the Japs. ★ When the two bombs—one ton under each wing—are released, the Lightnings continue in combat as fighters—a dual attainment made possible by the engines' extremely light weight, less than one pound per horsepower,* which gives the plane superlative lifting power as well as speed. ★ This extreme light weight—long the dream of engineers the world over—is a product of Allison precision and skill in handling metals—a precision and skill which will mark any product ever bearing the Allison name.

KEEP AMERICA STRONG
BUY MORE WAR BONDS

POWERED BY ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Warhawk
A-36 and P-51A—Mustang
P-63—Kingcobra

**Actual weight of Allison engine is 7/8 lb. per hp. Allison was first engine of less than one lb. per hp.*

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF

Indianapolis, Indiana

GM
GENERAL MOTORS

Every Sunday Afternoon—GENERAL MOTORS SYMPHONY OF THE AIR—*NBC Network*

For Utmost Dependability...

WITTEK *Aviation* HOSE CLAMPS

Type WWD Stainless Steel worm-drive adjustable hose clamp. Made in eight sizes to cover the entire range of applications.

Type FBSS Stainless Steel hose clamp. The most widely used hose clamp in the aviation industry. Made in the standard AN 748 sizes . . . also additional sizes for special requirements.

Dependability has been recognized by the Wittek Manufacturing Company during its 25 years of hose clamp manufacturing experience as a foremost requirement in any hose clamp design. Wittek assures this dependability by the selection of basically sound designs . . . the use of high-grade materials and the application of good workmanship. Today Wittek offers two distinctly different hose clamp designs—each of which meets the requirements of Specification AN-FF-C-406 A.

TYPE WWD—an adjustable worm drive hose clamp made of stainless steel and designed to take full advantage of the superior physical properties of that material. Note the compact streamlined housing . . . the hardened one-piece thumbscrew—PLUS a new exclusive Wittek feature—an inner band of Stainless Steel accomplishing the two-fold purpose; (1) protecting the hose from the serrations in the outer band, and (2) distributing the load uniformally to provide greater strength and superior sealing characteristics.

TYPE FBSS—an improved Stainless Steel version of Wittek's basic FB design—now incorporating a bridge extender—in all sizes. This is the most effective hose clamp for all applications where an adjustable clamp is not necessary.

Hose Clamps for all requirements, made by Wittek—specialists in hose clamps and their applications.

ARMY E NAVY

Your Bonds for Victory . . . Buy More Than Ever Before!

WITTEK MANUFACTURING CO.
4503-15 W. 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS

One of the most important changes is the elimination of horsepower ratings. In lieu of this rating, recent experience in an aircraft in a horsepower range within 50 per cent of that of the aircraft to be flown is required within the preceding 90 days if passengers are to be carried.

Part 43, General Operation Rules, requires the logging of only that flight time necessary to substantiate recent experience or that experience necessary to qualify for other pilot certificates or ratings and permits approved mechanical devices for the recording of aircraft flight time and engine running time. While the 100-hour periodic inspection is still required for aircraft operated commercially, aircraft not so operated need have only an annual inspection, which may be performed by a person designated by the Administrator. Another major change is that which permits solo flight in any type of aircraft by a pilot holding a valid pilot certificate, regardless of his particular aircraft rating.

Part 49,Transportation of Explosives and Other Dangerous Articles, represents no change in substance but merely groups these rules formerly under Part 60 in a part by themselves.

Part 60, Air Traffic Rules, with its modified visibility and proximity to cloud minimums literally gives the first 1,000 ft. of airspace back to the pilot who is interested only in contact flight. This rule will permit flight under contact-flight rules immediately below the base of the overcast up to a height of 1,000 ft. above the surface of the ground or water, except in the vicinity of airports where instrument approaches are made. To provide adequate separation between contact and instrument flight, the minimum altitude for the latter is raised from 1,000 ft. to 1,500 ft. above the terrain. This permits safe training operations and local flights around many outlying airports under conditions that prohibit contact flight under the present rules. This rule is combined with a new visibility minimum of 1 mile off airways or on airways below 1,000 ft., except in the vicinity of airports used for instrument approaches. While 500-ft. altitude above the terrain remains the general minimum for contact flight, the rule now permits flight at lower altitudes where such flights will not involve hazard to persons or property on the ground.

Connecticut State Department of Education

Educational Implications of the Air Age for Connecticut Schools and Colleges. Mary Louise Aiken. A monograph of 100 pages contains a review of the educational plans being carried out in the elementary and secondary schools, colleges, and vocational schools in the State of Connecticut. Appendixes contain lists of airports in Connecticut, a bulletin about flight experience as a part of a laboratory program, suggestions for laboratory exercises, and a bibliography.

Department of Agriculture

Technical Reports About Woods. The following reports have been made available in the series issued by the Forest Service of the U.S. Department of Agriculture, in cooperation with the University of Wisconsin. Several of the reports are issued in cooperation with the Army-Navy-Civil Committee on Aircraft Design Criteria under the supervision of the Aeronautical Board and some of them contain information derived by the Division of Forest Pathology, in cooperation with Yale University and with other Government agencies. The publications are as follows:

Supplement to Buckling of Flat Plywood Plates in Compression, Shear, or Combined Compression and Shear: Buckling of Flat Plywood Plates in Uniform Shear with Face Grain at 0°, 45°, and 90°, No. 1316-H, February, 1945.

Supplement to Design of Plywood Webs in Box Beams: Additional Tests of Box Beams and I-Beams to Substantiate Further the Design Curves for Plywood Webs in Box Beams—Tests of Plywood Webs in the Tension Field, No. 1318-C, August, 1944.

Analysis for Filler Content of Urea-Formaldehyde Glues, No. 1333, September, 1944.

Forest Products Laboratory Resin-Treated, Laminated, Compressed Wood (Compreg), No. 1381, July, 1944.

Longitudinal Shrinkage of Balsa, No. 1364, December, 1944.

Effect of Moisture Changes on the Shrinking, Swelling, Specific Gravity, Air or Void Space, Weight and Similar Properties of Wood, No. R1448, August, 1944.

Wartime Status of Sawdust, Shavings, and Other Wood Waste as Commercial Raw Materials, No. 1450, July, 1944.

Utilization of Less Commonly Used Species and Waste and the Improvement of Yield in Pulp Manufacture, No. R1451, June, 1944.

A Study of Methods of Measuring the Water Repellency of Water Repellents and Water-Repellent Preservatives for Wood, No. R1453, October, 1944.

A Review of Wood Saccharification Processes in the United States Prior to World War II, No. R1454, September, 1944.

Hydrolysis of Wood in a Stationary Digester by Successive Treatments with Dilute Sulfuric Acid, No. R1455, September, 1944.

The Rotary Digester in Wood Saccharification, No. R1456, September, 1944.

Kinetics of the Hydrolysis of Wood and of the Decomposition of Sugars in Dilute Acid at High Temperatures, No. R1457, September, 1944.

The Quantitative Saccharification of Wood and Cellulose, No. R1458, September, 1944.

Analysis of Wood Sugars, No. R1459, September, 1944.

Wood in War and Peace, No. R1460, October, 1944.

Test for Shipping Containers in Revolving Hexagonal Drum Box-Testing Machines, No. R1462, October, 1944.

Gasogens, No. R1463, November, 1944.

Ignition and Charring Temperatures of Wood, No. R1464, November, 1944.

Wood in the National Economy, No. R1465, November, 1944.

Fodder Yeast from Wood Sugar, No. R1467, December, 1944.

Fermentation of Wood Sugars to Ethyl Alcohol, No. R1466, December, 1944.

Wet-Strengthened Fiberboard from Reclaimed Fiber, No. R1469, December, 1944.

Tests of Solid Fiberboard Boxes Made of Wet-Strengthened Reclaimed Material, No. R1470, January, 1945.

Strength of Glued Laminated Sitka Spruce Made Up of Rotary-Cut Veneers, No. 1512, August, 1944.

Effect of Length on the Buckling Stresses of Thin-Walled, Plywood Cylinders in Axial Compression, No. 1514, September, 1944.

A Comparison of Shearing Strengths of Glued Joints at Various Grain Directions as Determined by Four Methods of Test, No. 1522, January, 1945.

Effect of Rapid Loading and Duration of Stress on the Strength Properties of Wood Tested in Compression and Flexure, No. 1518, January, 1945.

Effect of Moisture on the Compressive, Bending, and Shear Strengths, and on the Toughness of Plywood, No. 1519, January, 1945.

Effect of Hydraulic-Equipment Oils on the Bending and Compressive Strength of Sitka Spruce, No. 1520, January, 1945.

Factors Affecting the Strength of Papreg: Some Strength Properties at Elevated and Subnormal Temperatures, No. 1521, January, 1945.

Factors Affecting the Strength of Papreg: Effect of Accelerated Weathering in Certain Strength Properties of Papreg, No. 1521-A, January, 1945.

Factors Affecting the Strength of Papreg: Effect of Moisture on Certain Strength Properties of Papreg, No. 1521-B, January, 1945.

Factors Affecting the Strength of Papreg: Effect of Repeated Cycles of Freezing and Thawing on Certain Strength Properties of Papreg, No. 1521-C, January, 1945.

Bolt-Bearing Strength of Wood and Modified Wood: Effects of Different Methods of Drilling Bolt Holes in Wood and Plywood, No. 1523, December, 1944.

The Influence of Moisture Changes in Wood on the Shearing Strength of Glued-Joint Assemblies, No. 1524, January, 1945.

Heat-Stabilized Compressed Wood (Staypak), No. 1580, Revised, December, 1944.

Properties of Laminated Plastics Made from Lignin and Lignin-Phenolic Resin-Impregnated Papers, No. 1595, August, 1944.

The Significance of Black Line Stain in Yellow Birch Propeller Lumber, Forest Pathology Special Release No. 23, February, 1945.

Color Tests for Differentiating Heartwood and Sapwood of Certain Oaks and Pines, Technical Note No. 253, January, 1945.

Small Sawmill Improvement, Practical Pointers to Field Agencies, Small Mill Conveyor, 4S2224, September, 1944.

Small Sawmill Improvement, Practical Pointers to Field Agencies: Burning Waste Material, 4S2225, October, 1944.

Department of Commerce

The Businessman's Bureau. A booklet of 74 pages has been prepared to provide a ready reference to the services rendered to the businessman by the Bureau of Foreign and Domestic Commerce. No attempt is made to go into the complete ramifications of the Bureau's activities, but the information given is designed to acquaint readers with the functions of the Bureau and to point out some of the major results of its endeavors. The booklet contains five principal sections, the first dealing with the international and domestic activities and publications of the Bureau. Another section lists the officers and director of personnel, the third section is a geographic index, and the fourth is a commodity index. An index of the publications of the department constitutes the fifth section. *Economic Series No. 40, Bureau of Foreign and Domestic Commerce.*

Industrial Reference Service. Additional pamphlets are available in the series of analyses of the potential markets for air-cargo traffic between the United States and different foreign countries, especially South American countries. Previous issues have given the studies with respect to Argentina, Brazil, Columbia, Paraguay, Peru, Union of South Africa, Uruguay, and Venezuela. A current report devoted to Chile is dated February, 1945, and one on Bolivia, March, 1945. *Bureau of Foreign and Domestic Commerce, Transportation Unit.* For sale by the Superintendent of Documents, $0.05 for each report; annual subscription, $1.50 per volume.

National Advisory Committee for Aeronautics

Calculation of Centrally Loaded Thin-Walled Columns Above the Buckling Limit. F. Reinitzhuber. Translation of "Beitrag zur Berechung gedrucketer, dunwandiger Profile oberhalb der Beulgrenze," from *Luftfahrtforschung*, July 20, 1942. The present report is an attempt to investigate theoretically the behavior of short, thin-walled columns above the buckling load, by means of the conventional calculating methods. When thin-walled columns formed from flanged sheet, such as used in airplane construction, are subjected to axial load, their behavior at failure varies according to the slenderness ratio. The cross section of the column selected was a square, which by reason of its symmetric properties lends itself best to mathematical treatment. The writer explains the theory on which the work is based, then describes the experimental methods through which the results were checked. *Technical Memorandum No. 1077*, April, 1945.

Navy Department

Data on Naval Aircraft. A mimeographed pamphlet of 44 pages contains tabulated specifications of the various types of naval aircraft. The information is classified under the headings of fighters, dive bombers, torpedo bombers, patrol bombers, scouts, transports, utility craft, trainers, and lighter-than-air craft. It gives the naval designations of the different types of aircraft, together with the names that have been assigned to those types. The specifications are prepared in a uniform manner outlining the type, construction, speed, service ceiling, range, tactical radius, crew, weight, dimensions, bomb load, armament, power plant, and protection. *Navy Department, Office of Public Relations*, Washington.

Office of War Mobilization

Second Report to the President, the Senate, and the House of Representatives by the Director of War Mobilization and Reconversion. The second quarterly report of the Director of War Mobilization and Reconversion deals with the operations of the office for the period ending March 31, 1945. Its contents include four main parts, the first being a review of the task of production up to VE-Day and the state of the economy at the time of the report. Other sections deal with production controls, prices, employment and other problems, and post VJ-Day reconversion policies. There is also a review of the operations of the executive departments and advisory boards of the O.W.M.R. and an appendix outlining the policies of contract curtailment, nonrenewal, and termination. The booklet contains many charts giving statistics about production and other economic factors.

State of Indiana

An Aviation Program for Indiana is a booklet of 66 pages, prepared with the collaboration of the Civil Aeronautics Administration and the State Highway Commission. It proposes a program of participation in aviation for the State of Indiana, its municipalities, and citizens. It is divided into three main parts, the first outlining the airport system for Indiana, the second setting forth the responsibility of local communities, and part three the responsibility of the state government. *Bulletin No. 3, Indiana Economic Council*, Indianapolis.

Australian Military Forces

The Australian Army at War. An illustrated booklet of 64 pages gives a brief but comprehensive factual summary of the services rendered by the armed forces of the Commonwealth of Australia since the outbreak of the war in September, 1939. It lists the 28 territories in which Australian soldiers have fought, tracing the action in each major territory. The services of the air arms are emphasized throughout the detailed accounts. A chapter relates the story of civilian activities in supporting the armed forces, and a list is given of the awards and decorations won by members of the Australian Army. The war diary of the Army up to July, 1944, concludes the account. *Australian News and Information Bureau*, New York.

British Air Ministry

Instructions to Observers at Synoptic Stations. The seventh edition of Supplement No. 1 to the Meteorological Observer's Handbook is a continuation of "Instructions for Meteorological Telegraphy." It outlines the duties of observers, the instruments used, the hours of observation, and the coding of messages. This is followed by detailed directions for the observations to be taken and for the operation of meteorologic instruments. *Meteorological Office, MO 191/1 (1944). British Information Services*, New York, $0.40.

The Air Battle of Malta, a booklet of 95 pages, contains the official account of the Royal Air Force in Malta from June, 1940, to November, 1942. With the aid of numerous illustrations, including aerial photographs, it describes the unsuccessful effort of the enemy to conquer the island and recites the exploits of the air force and other units of the British armed forces in the defense of the island. *British Information Services*, New York, $0.30.

Atlantic Bridge is the official account of the Royal Air Force Transport Command's ocean ferry. It traces the origin of the air-transport service and its growth, with information about the aircraft used and many other phases of the activity of the Command. Separate chapters give the story of the operations across the North Atlantic and the South Atlantic. *British Information Services*, New York, $0.15.

British Air Registration Board

British Civil Airworthiness Requirements. The following new and revised sheets have been added to the regulations governing the procedure for airworthiness certification of British civil aircraft: A.8, Issue 1, February, 1945, Overhauls, Repairs, and Replacements to Aircraft; A.9, Issue 2, Feb-

Aeroprops will save places for two

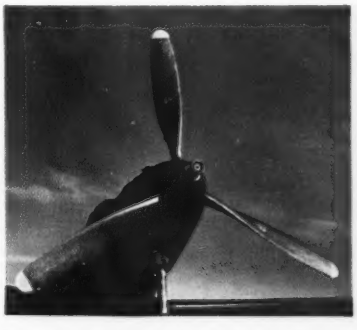
This Propeller's Battle-Tested Lightness Will Be a Payload Factor Soon

WHETHER it's a happy honeymooning couple, or less romantic payload, the pounds Aeroproducts has trimmed from propeller weight will make possible this additional plane capacity for peacetime flying.

Lightness is not the only factor that recommends this General Motors propeller. Its automatic, constant speed operation, simple unit construction, and ribbed-steel hollow blades are among the many features important to flying's future.

Like all General Motors products, the Aeroprop is the result of intensive research, engineering, and production developments. Built to more than meet war's demanding standards, battle-tested on every front, it will be ready to contribute equally to the progress of peacetime flight.

Today the Aeroprop serves flyers who have "dates" with Victory. It will serve tomorrow's honeymooning couples—and others who fly—with the same efficiency.



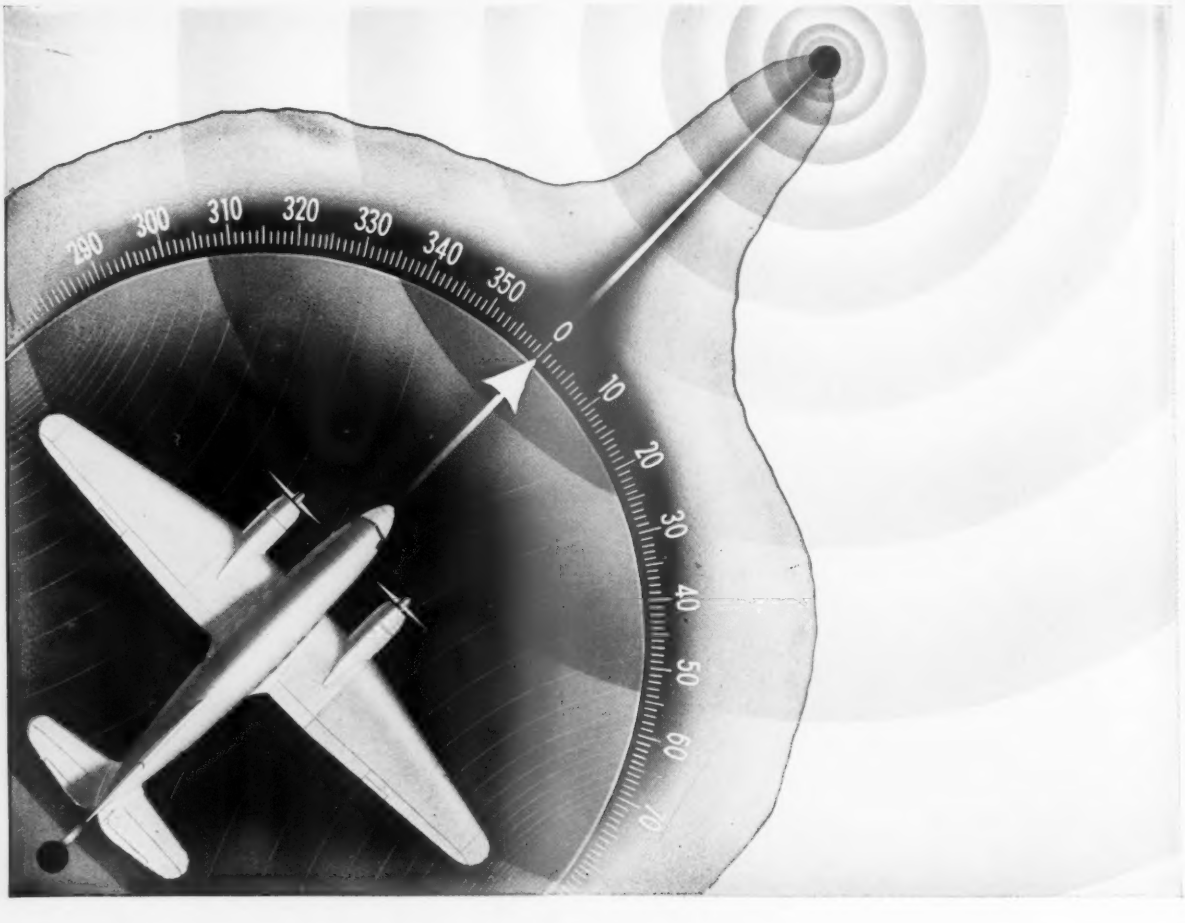
Aeroprop Advantages—*Lightness* for payload . . . *Strength* for safety . . . *Simplicity* for easy service . . . *Faster Automatic Pitch Change* for flight efficiency . . . *Full Feathering* for engine protection . . . *Engineered* for reliability.

Aeroprop

LIGHT • STRONG • RELIABLE

AEROPRODUCTS DIVISION • GENERAL MOTORS CORPORATION • DAYTON, OHIO

Keep them flying—Buy Another War Bond!



Fly the Pointer

IT'S as simple as that! With the Sperry Automatic Radio Direction Finder, the pilot can quickly obtain the bearing of a radio station, check the drift, and *fly the pointer* home.

The Sperry Automatic Radio Direction Finder gives the pilot *continuous* and *automatic* non-ambiguous bearing indications, and simultaneous headphone reception. Even under conditions of severe rain, dust, or snow, static-free reception is maintained through the use of *shielded* crossed loops.

The non-hunting pointer indicates the correct bearing regardless of the maneuvers of the airplane or the effects of turbulent air . . . there is no overshooting of the pointer. This feature, together with a very high pointer speed, is extremely desirable for quick correction of drift when small changes in course are made.

Bearings may be taken on very weak signals . . . under favorable conditions reception is effective up to 1500 miles.

The Sperry Automatic Radio Direction Finder includes a self-contained power supply . . . 12 or 24-volt operation is available by throwing one switch on the receiver. Remote bearing indicators may be used, if desired.

Write our Aeronautical Department for further information.

The Sperry Automatic Radio Direction Finder is used by TWA, Braniff, Colonial, Northeast, Alaska, and American Airlines.

SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

★

Division of the Sperry Corporation

LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS
CLEVELAND • BROOKLYN • HONOLULU

GYROSCOPICS • ELECTRONICS • RADAR • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

ruary, 1945, Type Records; A.10, Issue 1, March, 1945, Weighing of Aircraft; A.11, Issue 1, March, 1945, Design Organizations (Aircraft). *Air Registration Board*, London, 6*d*. each.

British Information Services

Note on Errors Arising in Measurements of Turbulence. L. F. G. Simmons. With the object of finding the cause of certain discrepancies in the measurements of turbulence in the airflow of a wind tunnel at the National Physics Laboratory, an examination was made of errors common to the hot-wire technique employed. In the absence of any known method of producing pulsating velocities of a definite magnitude, an overall calibration of the apparatus was made by oscillating the wire regularly in a steady jet of air, and comparing the measured and calculated velocity variations arising from the motion. Experiments were also undertaken to determine the "time constant" M of the wire, on which the compensation of the amplifier depends, and the phase angle ϕ to verify the theoretic relation $\tan \phi = M\omega$.

There are three main sources of error. The first occurs in the measurements of constants relating to the wire and to the electrical circuits; the second concerns changes in the rate of cooling of the wire attributable to particles of matter accidentally adhering to the surface, while the third arises through variations in the flow brought about by gustiness of the atmosphere. If the law of cooling is determined for a clean wire, the combined error arising from the first two causes will not exceed ± 2.5 per cent; on the other hand, for a contaminated wire it may be as large as 15 per cent. On gusty days the turbulence in an N.P.L. type of tunnel may be increased by as much as 10 per cent above the normal value; for a return-flow tunnel the corresponding figure is considerably smaller. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1919*, British Information Services, New York, $0.75.

Calculations of Derivatives for Rectangular Wings of Finite Span by Cicala's Method. W. P. Jones and Sylvia W. Skaw. A brief description is given of Cicala's theory of the non-uniform motion of wings of finite span, with special reference to wings of rectangular plan form. The method is applied to calculate by successive approximations values of the derivatives appropriate to two simple modes of motion, namely: (1) pitching oscillations of a rigid airfoil about the half-chord axis; (2) torsional oscillations of a semirigid wing about the half-chord axis, with the twist assumed to increase linearly with distance along the span. The aspect ratios assumed are 6 and 2.7 in Case (1) and 6 in Case (2).

The results are plotted against frequency parameter. In the same diagrams comparisons are made with corresponding derivatives calculated by the usual two-dimensional vortex sheet theory and by Lyon's theory for finite span. Curves based on some relevant derivative measurements in a 4-ft. wind tunnel at the N.P.L. also are included.

It appears, according to the writers, that Cicala's method is definitely superior to Lyon's method from the standpoint of rapidity of convergence. However, the limiting values given by Lyon's method may be expected to be closer to the true derivatives than those given by Cicala's method, since Cicala introduces certain extraneous vortices for convenience and treats their effects as negligible, and also makes a number of questionable assumptions in his analysis. Before the relative merits of the two theories can be fully judged in relation to practice, more complete experimental information is necessary. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1920*, British Information Services, New York, $0.60.

The Stabilization of Struts by Lateral Support. H. L. Cox. The weight of material necessary to transmit a compressive load over a distance by means of a simple strut is a definite function of the "structure loading coefficient" and of the properties of the material of which the strut is made. If the structure loading coefficient is low, the stress in the most economical strut may be much less than the actual strength of the material. In such cases, if it is possible to brace the strut laterally, the total weight of the structure may be reduced. The conditions governing this possibility are examined. Two cases are considered, that of a strut free to deflect laterally in any plane and that of a strut constrained to deflect in one plane only. The bearing of the results on the problem of a bent beam is discussed. It is concluded that the use of lateral ties to stabilize struts at low values of structure loading coefficient may result in a considerable saving of weight, even in cases where the length of the ties considerably exceeds that of the strut. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1922*, British Information Services, New York, $0.60.

A Theoretical Analysis of the Impact of an Elastic Body on Water. S. V. Fagg. Of the factors which affect the forces arising during the alighting of a flying boat, one of the most important is the elasticity of the hull and wings. This short report describes a theoretic analysis for the case of the sprung keeled float, taking into account the mass of the float. As a first step towards investigating the effects of hull and wing flexibility on the loads arising on flying boats when alighting, some preliminary calculations on the impact of an idealized elastic hull on water have been made. This idealized body consists of a rigid mass simply connected by a massless spring to a rigid V bottom. The body is considered as dropping into water and the accelerations of the main mass and of the V bottom are calculated. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1925*, British Information Services, New York, $0.25.

British Ministry of Supply

The Turning of Aluminium Pistons with Diamond Tools. A 10-page pamphlet gives some of the conclusions about the type of work for which diamond tools are especially suitable, the type of tools best suited to each class of work, the proper method of use, and the conditions under which specific results can be obtained. The records of surface finish obtained are given in charts and tables, and the text contains detailed information about the work and the equipment used. *Ministry of Supply, Tool Technical Panel, Diamond Die and Tool Control, July, 1943*. British Information Services, New York, $0.15.

Canadian Department of Trade and Commerce

Civil Aviation in Canada 1943. A 9-page pamphlet gives a brief review of the various aspects of civil aviation in Canada in 1943. Tabulated statistics give detailed information about the volume, mileage, and classifications of civil air traffic in the Dominion. Figures are included for the number and types of aircraft in operation, the number and types of airports, and the numbers of government and private employees engaged in civil aviation. *Dominion Bureau of Statistics, Public Utilities Branch*, Ottawa, 1945, $0.10.

Netherlands Government Information Bureau

Military Operations in the Netherlands. P. L. G. Doorman, translated from the Dutch by S. L. Salzedo. This is an account of the invasion of Holland and the subsequent brief campaign that brought to an end the bombing of Rotterdam. It deals with military operations from the tenth to the seventeenth of May, 1940. The book is based upon material in the possession of the Netherlands Department of War in London and is published for the Netherlands Government Information Bureau by George Allen & Unwin, Ltd., London, 5*s*.

Polish Ministry of Industry, Commerce, and Shipping

Poland's Share in Pre-War Transport. This paper-covered booklet contains a review of commercial aviation in Poland from the close of the first World War to the latter part of 1939. It includes brief descriptions of the air-line services operated in those years—routes and mileages and tabulated data for the numbers of passengers, passenger-miles, mails, and freight transported. Information is also given about international agreements related to air navigation to which Poland was a party. Numerous maps and charts visualize the statistical data.

Fiberglas-plastics fabrications by United States Rubber Company for Nash-Kelvinator Corporation.

FIBERGLAS*- REINFORCED PLASTICS

—a spectacular, new, lightweight

Structural Material

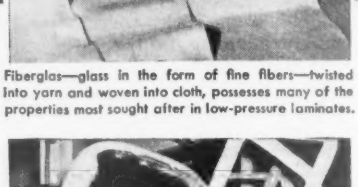
Aircraft structural parts, such as the cabin structure of the Army R-6 Helicopter, are now being made of plastics reinforced with Fiberglas — fine filaments of glass woven into cloth, then used with low-pressure resins in the fabrication of extremely strong, lightweight laminated plastics parts.

Fiberglas textiles are resistant to moisture, therefore are dimensionally stable. They possess great tensile strength, and are resistant to heat, oils, corrosive vapors and most acids.

The combination of Fiberglas and certain low-pressure resins has resulted in a material with properties which excel those of any material previously available for commercial use. For example, impact strength from five to ten times that previously obtained in laminates is now attained through Fiberglas reinforcement. Higher strength-to-weight ratios, greater rigidity, dimensional stability and simplified fabrication are but a few of the advantages which are resulting in the rapidly increasing use of Fiberglas for reinforced plastics sheets and formed parts.

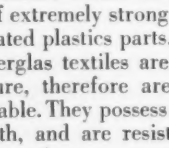
Samples and complete information on Fiberglas Textiles will be sent to you on request. Owens-Corning Fiberglas Corp. does not manufacture resins or finished laminates but will be glad to furnish data on techniques in the use of Fiberglas and low-pressure resins. Write: *Owens-Corning Fiberglas Corp., 1893 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ont.*

Fiberglas—glass in the form of fine fibers—twisted into yarn and woven into cloth, possesses many of the properties most sought after in low-pressure laminates.



R-6 cabin structure of Fiberglas-reinforced plastic being trimmed and made ready by U.S. Rubber for shipment to Nash-Kelvinator.

The R-6 Helicopter which will be used to transport wounded from inaccessible combat areas and will service military outposts with supplies.



FIBERGLAS .. A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for single issues and yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The frequency of publication is indicated by the following symbols: M, monthly; SM, semimonthly; BM, bimonthly; W, weekly; BW, biweekly; D, daily; Irreg., irregularly; Q, quarterly.

Periodicals

Aero Digest, 515 Madison Ave., New York 22, N.Y., SM, $0.50, $3.00.

The Aero Field, Francis J. Field, Ltd., Sutton Coldfield, England, 10 issues per year, 6d., 5s.

Aero Products, 271 Madison Ave., New York 16, N.Y., M.

Aeromodeller, Wilmary House, Merton Lane, Highgate, London, N. 6, M, 1s., 15s.

Aeronáutica, Avda. de Mayo 1370, Buenos Aires, M, $0.60 (pesos), $4.50 (pesos).

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, M, 2s., 26s. 6d.

The Aeroplane, Bowling Green Lane, London, E.C.1, W, 1s., 58s.

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, BW, 3d., 8s. 8d.

Air Age Education News, Air Age Education Research, 100 E. 42d St., New York 17, N.Y., BM.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.25, $3.00.

Air Mail Magazine, A. Phillips, Newport, Monmouthshire, M, 4d., 5s.

Air News, 545 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Air Pilot and Technician, 515 Madison Avenue, New York 22, N.Y., M, $0.35, $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., M, $0.25, $2.50.

Air Trails Pictorial, 122 E. 42d St., New York 17, N.Y., M, $0.25, $2.50.

Air Transport, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., M, $0.50, $5.00.

Air World, 241 Church St., New York 13, N.Y., BM, $0.15, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, M, 1s. per issue.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C,1, M, 2s. 3d., 26s.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, M, 2s. 6d., £1 14s. 6d.

Airlanes, 340 W. 57th St., New York 19, N.Y., M, $0.25, $2.50.

Airmail Digest, Charles B. Charmatz, Sylvania, Ohio, Irreg.

Airports, 1170 Broadway, New York 1, N.Y., M, $0.25, $3.00.

Aluminum and Magnesium, 425 W. 25th St., New York 1, N.Y., M, $3.00 yr.

American Aviation, American Bldg., Washington 4, D.C., SM, $0.25, $4.00.

American Aviation Daily, American Bldg., Washington 4, D.C., D, $170 yr.

American Aviation Directory, American Bldg., Washington 4, D.C., Semi-annually, $5.00, $7.50.

American Aviation Traffic Guide, 139 N. Clark St., Chicago 2, Ill., M, $0.50, $5.00.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., M, $0.25, $3.00.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 22, Pa., SM, $0.25, $1.00.

Avia, Victoria 788, Buenos Aires, M, $0.50 (*m/n*), $5.00 (*m/n*).

Aviação, Rua Uruguiana, 104, Rio de Janeiro, M, $4.00 (cruzeiros), $40 (cruzeiros).

Aviación, 429 H. W. Hellman Bldg., Los Angeles 13, Calif., BM, $1.00 yr.

Aviation, 330 W. 42d St., New York 18, N.Y., M, $0.50, $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., M, $0.25, $2.00.

Aviation Equipment, 1170 Broadway, New York 1, N.Y., M.

Aviation Maintenance, 205 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Aviation News, 1357 National Press Bldg., Washington 4, D.C., W, $0.50, $5.00.

Aviation Review, 31 Willcocks St., Toronto 5, Ontario, M, $0.25, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill., BM.

British Plastics, Dorset House, Stamford St., London, S.E.1, M, 1s. 6d., 20s.

Canadian Air Cadet, 122 Wellington St., Ottawa, Ontario, M, $0.10, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, Ontario, M, $0.25, $2.00.

Chile Aéreo, Club Aéreo de Chile, Av. Bulnes 80, Santiago de Chile, M, $5.00 (pesos), $50 (pesos).

Collier's, The Crowell-Collier Publishing Co., Springfield, Ohio, W, $0.10, $3.00.

Commercial Aviation, 341 Church St., Toronto, Ontario, M, $0.25, $3.00.

Contact, 113 W. 42d St., New York 18, N.Y., M, $0.20, $2.00.

Current Aviation, 400 S. Front St., Columbus 15, Ohio, W, $0.80 yr.

D and W, 100 E. 42d St., New York 17, N.Y., M, $0.30, $3.00.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., M, $0.35, $3.00.

EMCO Monthly Journal, Marks Stamp Co., Ltd., 258 College St., Toronto 2, Ontario, M, $0.50 yr.

The Engineer, 28 Essex St., Strand, London, W.C.2, W, 1s., £3 3s.

Engineering, 35 Bedford St., Strand, London, W.C.2, W, 1s. 2½d., £3 3s.

Engineering Materials and International Power Review, Africa House, Kingsway, London, W.C.2, BM, 3s., 15s.

Engineering News-Record, 330 W. 42d St., New York 18, N.Y., W, $5.00 yr.

The Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N.Y., M, $0.75, $7.50.

Flight, Dorset House, Stamford St., London, S.E.1, W, 1s., £3 1s.

Flying, 185 N. Wabash Ave., Chicago 1, Ill., M, $0.35, $4.00.

Flying Aces, 67 W. 44th St., New York 18, N.Y., M, $0.15, $1.80.

Gliding, 4658 Portage Rd., Kalamazoo 85, Mich., M, $0.25, $3.00.

Heating and Ventilating, 148 Lafayette St., New York 13, N.Y., M, $0.30, $2.00.

Indian Aviation, 13 Ezra Mansions, P.O. Box 2361, Calcutta, India, M, 8 annas, 7 rupees 8 annas.

Industrial Aviation, 185 N. Wabash Ave., Chicago 1, Ill., M, $2.00 yr.

Industrial Engineering, 416 Wall St., Los Angeles 13, Calif., M, $2.00 yr.

Industrial Standardization, American Standards Assn., 70 E. 45th St., New York 17, N.Y., M, $0.35, $4.00.

Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa., M, $2.00 yr.

International Aviation (Foreign News Supplement to American Aviation Daily), American Building, Washington 4, D.C., W, $100 yr.

Iron Age, 100 E. 42d St., New York 17, N.Y., W, $0.35, $8.00.

Kunststoffe, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $15 yr.

Light Metals, Bowling Green Lane, London, E.C.4, M, 1s. 6d., 20s.

Luftfahrtforschung, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $12 yr.

Machine Design, Penton Bldg., Cleveland 13, Ohio, M, $0.50, $6.00.

Machinery, 148 Lafayette St., New York 13, N.Y., M, $0.40, $4.00.

Mechanix Illustrated, 1501 W. Broadway, New York 18, N.Y., M, $0.15, $1.80.

Metals and Alloys, 330 W. 42d St., New York 18, N.Y., M, $0.25, $2.00.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., M, $0.50, $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Modern Plastics, 122 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Modern Transport, 105–109, Strand, London, W.C.2, W, 3d., 20s.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, M, $0.30 (pesos), $4.00 (pesos).

The N.A.T.A. Dispatch, National Aviation Trades Assn., 214 E. Armour Blvd., Kansas City 2, Mo., 36 issues per yr.

Official Aircraft Price Guide, Aircraft Advisory Service, Inc., P.O. Box 81, Columbus 16, Ohio, Q, $6.50 yr.

The Official Foreign Air Mail Guide, 11 W. 42d St., New York 18, N.Y., M, $1.50 yr.

The Official Guide of the Airways, 608 S. Dearborn St., Chicago 5, Ill., M, $0.50, $5.00.

Pacific Plastics, 124 W. 4th St., Los Angeles 13, Calif., M, $0.30, $3.00.

Plastics, 540 N. Michigan Ave., Chicago 11, Ill., M, $5.00 yr.

Plastics, Bowling Green Lane, London, E.C.1, M, 1s. 6d., 19s.

Plastics and Resins, 299 Madison Ave., New York 17, N.Y., M, $0.35, $3.00.

Plastics Reporter, 1214 Hyde Park Ave., Hyde Park 36, Mass., M, $0.20, $2.00.

Plastics World, 551 5th Ave., New York 17, N.Y., M, $0.25, $3.00.

Popular Mechanics Magazine, 200 E. Ontario St., Chicago 11, Ill., M, $0.25, $2.50.

Popular Science Monthly, 353 4th Ave., New York 10, N.Y., M, $0.25, $2.50.

Product Engineering, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Production Equipment, 328 S. Jefferson St., Chicago 6, Ill., M.

Protar, Buchdruckerei Vogt-Schild AG., Solothurn, M, 1.00 Sw. Fr., 15 Sw. Fr.

Recent Periodical Articles, Library, Parks Air College, Inc., E. St. Louis, Ill., M, $5.00 yr.

Revista Aérea Latinoamericana, 515 Madison Ave., New York 22, N.Y., M, $0.15, $1.00.

Revista do Ar, Aero Clube de Portugal, Av. da Liberdade, 226, Lisboa, M, 120$00.

România Aeriană, Calea Floreasca Nr. 13, Bucharest, M.

Rutas del Aire, Melincué 2501, Buenos Aires, M, $0.30 (*m/n*), $3.50 (*m/n*).

The Saturday Evening Post, Independence Sq., Philadelphia 5, Pa., W, $0.10, $6.00.

Schweizer Aero-Revue, Hirschengraben 22, Zürich, M, 80 Rappen, 10 Sw. Fr.

Science Illustrated, 33 W. 42d St., New York 18, N.Y., M, $0.25, $3.00.

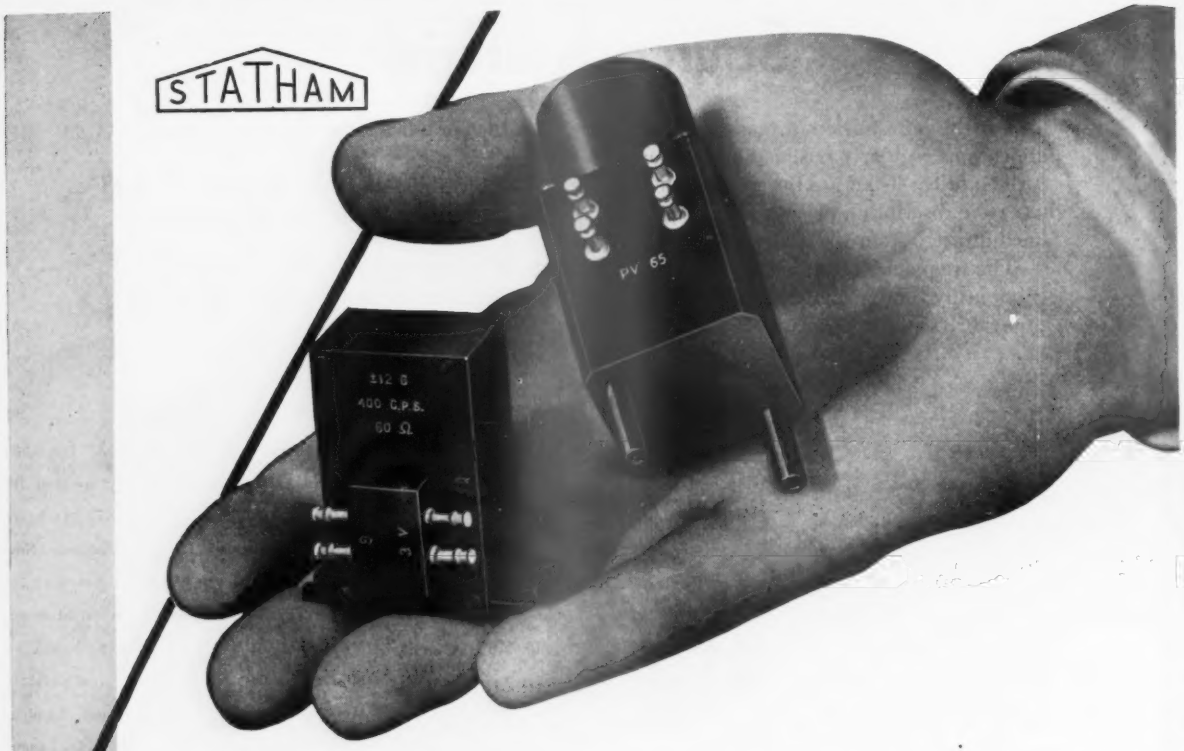
Scientific American, 24 W. 40th St., New York 18, N.Y., M, $0.35, $4.00.

Sheet Metal Industries, 49, Wellington St., London, W.C.2, M, 1s. 3d., 15s.

Skyways, 444 Madison Ave., New York 22, N.Y., M, $0.25, $3.00.

Southern Flight, 1901 McKinney Ave., Dallas 1, Tex., M, $0.25, $2.00.

Steel Processing, 108 Smithfield St., Pittsburgh 30, Pa., M, $0.25, $2.50.



for **TEST ENGINEERS**

Statham developments keep pace with your requirements. At last, Accelerometers and Pressure Transmitters which:

- Don't require amplifiers
- Need no balancing
- Operate from simple batteries direct to your oscillograph galvanometers
- Place no limitation on cable length
- Have high undistorted frequency response
- Possess temperature stability
- Are linear and accurate
- Maintain calibration permanently
- Are of durable construction
- AND, are small and light weight.

For further information write

STATHAM LABORATORIES INSTRUMENT MAKERS
8222 BEVERLY BOULEVARD • LOS ANGELES 36, CALIFORNIA

MODEL AP ACCELEROMETER—For accelerations up to 12 G or more at frequencies of 0-250 c.p.s. Used in performance tests, landing gear drop tests, etc.

MODEL AQ ACCELEROMETER—For accelerations up to 1½ G at frequencies 0-50 c.p.s. Excellent for brake testing.

MODEL PV PRESSURE TRANSMITTER—For air speed, altitude, boundary layer pressures, manifold pressures, etc.

MODEL PW PRESSURE TRANSMITTER—For hydraulic fluid pressures, fuel pressures, etc.

Trade-a-Plane Service, Crossville, Tenn., 3 issues per month, $0.25 yr.

U. S. Air Services, Transportation Bldg., Washington 6, D.C., M, $0.25, $3.00.

V.D.I. Zeitschrift, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., W, $19 yr.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., M, $0.25, $2.00.

Wings, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Wings, 1 Marion St., Wellington, N.Z., M, 6*d*., 10*s*.

Wings, London House, 21 Loveday St., Johannesburg, Union of South Africa, M, 6*d*., 7*s*. 6*d*.

Society and University Publications

Accelerator, Metropolitan Section, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., 10 issues per yr.

Aero Mechanic, Aircraft Builders Lodge 751, A. F. of L., 5513 Airport Way, Seattle 8, Wash., W, $1.50.

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Aeronautical Chamber of Commerce of America, Inc., Weekly Washington Bulletin, 610 Shoreham Bldg., Washington 5, D.C., W.

Aeronautical Engineering Review, Institute of the Aeronautical Sciences, Inc., 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.30, $3.00.

The Air Force Woman, The National Assn. of Air Forces Women, 1702 K St., N.W., Washington 6, D.C., M.

The Air Line Mechanic, The Air Line Mechanics Assn., International, 155 N. Clark St., Chicago 1, Ill., M.

The Air Line Pilot, The Air Line Pilots Assn., International, 3145 W. 63d St., Chicago 29, Ill., M.

Air Training Corps Gazette, Published for the Air League of the British Empire by The Rolls House Publishing Co., Ltd., 2 Breams Bldgs., London, E. C. 4, M, 6*d*., 7*s*.

Air Transport Safety, National Safety Council, 20 North Wacker Drive, Chicago 6, Ill., M.

Airport Digest, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Airpost Journal, American Air Mail Society, Albion, Pa., M, $0.20, $2.00.

American Helicopter Society, Semi-Technical Bulletin, Newfield P.O. Box 4029, Bridgeport 7, Conn., Irreg., $0.50 per issue.

American Meteorological Society, Bulletin, Milton, Mass., M, $0.35, $3.50.

American Rocket Society, Journal (formerly Astronautics), 130 West 42d St., New York 18, N.Y., Q, $3.00 yr.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., BM, $0.25, $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Army Ordnance, Army Ordnance Assn., 705 Mills Bldg., Washington 6, D.C., BM, $0.75, $4.50.

Astro-Jet, Glendale Rocket Society, 3262 Castera Ave., Glendale 8, Calif., 3 issues per yr., $1.00 yr.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Aviation Progress, County Chamber of Commerce, Los Angeles, Calif., M.

Aviation Writers Assn., Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y., Irreg.

Boletín de Aviación, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., M.

Chirp, The Early Birds, Lt. Col. Ernest Jones, Secretary, 3401 16th St., N.W., Washington, D.C., Irreg.

Civil Air Patrol League, News, 545 5th Ave., New York 17, N.Y., M.

Conference of International Air Traffic Operators, Bulletin, 31-32, Haymarket, London, S.W.1, M, 1*s*., 10*s*. 6*d*.

Electrical Engineering, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N.Y., M, $1.50, $12.

Faraday Society, Transactions, 98 Great Russell Street, London, W.C.1, M, 5*s*. per issue.

Fasteners, American Institute of Bolt, Nut and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio, Q.

For Your Information, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., W.

The Foundation, Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich., M.

The Franklin Institute, Journal, Benjamin Franklin Parkway at 20th St., Philadelphia, Pa., M, $0.60, $6.00.

Haul Down and Ease Off, National Assn. of American Balloon Corps Veterans, P.O. Box 2040, Wichita, Kan., BM.

Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill., M, $0.25, $2.00.

Industrial Quality Control, Published by the Society of Quality Control Engineers in cooperation with the University of Buffalo, Crosby Hall, University of Buffalo, Buffalo 14, N.Y., BM, $1.25, $6.00.

Institute of Radio Engineers, Proceedings, 330 W. 42d St., New York 18, N.Y., M, $1.00, $10.

Institute of Transport, Journal, 15 Savoy St., Victoria Embankment, London, W.C.2, Q, 2*s*. 6*d*. per issue.

The Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.1, Q, 10*s*. 6*d*. per issue.

The Institution of Mechanical Engineers, Journal, Storeys Gate, St. James' Park, London, S. W. 1, 35*s*. yr.

Journal of Aeronautical Meteorology, Meteorological Committee, Air Transport Association of America, 10 Richards Road, Kansas City 6, Mo., Q, $0.50, $2.00.

Journal of Applied Mechanics, 29 W. 39th St., New York 18, N.Y., Q, $1.35, $5.00.

Journal of Applied Physics, 57 E. 55th St., New York 22, M, $0.70, $7.00.

Journal of Aviation Medicine, Aero Medical Assn. of the United States, 2642 University Avenue, St. Paul 4, Minn., BM, $1.25, $5.00.

The Journal of Engineering Education, Prince and Lemon Sts., Lancaster, Pa., 10 issues per year, $0.50, $3.00.

The Journal of Meteorology, American Meteorological Society, Milton 86, Mass., Q, $6.00 yr.

Journal of Scientific Instruments, The University, Reading, Berkshire, England, M, 3*s*. 4*d*., 40*s*.

Journal of the Aeronautical Sciences, Institute of the Aeronautical Sciences, Inc., 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., Q, $2.00, $7.00.

Mechanical Engineering, American Society of Mechanical Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $0.75, $6.00.

Metropolitan Airmail Cover Club, Bulletin, The Malin Studios, 225 W. 46th St., New York 19, N.Y., M.

Model Aviation, Air Youth Div., National Aeronautic Assn., 1025 Connecticut Ave., Washington 6, D.C., M, $1.00.

National Aeronautics, National Aeronautic Assn., 1025 Conn. Ave., Washington 6, D.C., M, $6.00 yr.

New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y., Irreg.

Ohio State University, Engineering Experiment Station, Bulletin, Columbus, O., BM.

Ohio State University, Engineering Experiment Station, News, Columbus, Ohio, M.

Pacific Aeronautical Library, Check-List, 6715 Hollywood Blvd., Los Angeles 28, Calif., Irreg.

Photogrammetric Engineering, The American Society of Photogrammetry, P.O. Box 18, Benjamin Franklin Sta., Washington, D.C., $1.50 per issue.

Planes, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Polish Engineering Review, Association of Polish Engineers in Canada, 3432 Drummond St., Montreal, Quebec, BM, $0.50, $3.00.

Press Summary, Society of British Aircraft Constructors, Ltd., 32, Saville Row, London, W.1, W.

Production Information, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Quarterly of Applied Mathematics, Brown University, Providence 12, R.I., Q, $2.00, $6.00.

The Review of Scientific Instruments, American Institute of Physics, 57 E. 55th St., New York 22, N.Y., M, $0.50, $5.00.

Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, M, 7*s*. 6*d*., £4 10*s*.

Royal Meteorological Society, Quarterly Journal, 49, Cromwell Rd., London, S.W.7, Q, 7*s*. 6*d*. per issue.

SAE Journal, Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N.Y., M, $1.00, $10.

Soaring, Soaring Society of America, Inc., Elmira, N.Y., BM, $4.00 yr.

Sociedad Cubana de Ciencias Físicas y Matemáticas, Revista, Habana, Cuba, Irreg., $0.50, $3.00 per vol. of 6 issues.

Standards Review, British Standards Instn., 28 Victoria St., Westminster, London, S.W.1, Q, 2*s*., 7*s*.

The Thermal, The Southern California Soaring Assn., Inc., 453 S. Spring St., Los Angeles 13, Calif., M, $2.00 yr.

United States Naval Institute, Proceedings, Annapolis, Md., M, $0.50, $4.00.

Virginia Polytechnic Institute, Engineering Experiment Station, Bulletin, Blacksburg, Va., 16 issues per yr.

War Medicine, American Medical Assn., 535 N. Dearborn St., Chicago 10, Ill., M, $0.75, $6.00.

Warplane Production, Aircraft War Production Council, Inc., 7046 Hollywood Blvd., Los Angeles 28, Calif., BM.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., Q, $0.50, $1.75.

The Welding Journal, 33 W. 39th St., New York 18, N.Y., M, $0.75, $5.00.

West Coast Air Mail Society, Bulletin, Ralph A. Freiburg, 4142 26th St., San Francisco 14, Calif., BM.

Wings Club, Inc., Bulletin, 50 Vanderbilt Ave., New York 17, N.Y., M.

Government Publications

Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1, M.

Aeronáutica, Clasificador F-468, Santiago de Chile, M, $6.00 (pesos), $50 (pesos).

Air Force, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Anahuac, Calle 21 Núm. 500 Col. Moctezuma, Mexico, D.F., $0.25 Mex., $3.00 Mex.

Army Life, Recruiting Publicity Bureau, U.S. Army, Governors Island, N.Y., M.

Army News, Bureau of Public Relations, War Dept., Washington 25, D.C., SM.

Australia, Council for Aeronautics, Reports, Box 4331, G.P.O., Melbourne, Irreg.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.40, $4.65.

CAP News Bulletin, Civil Air Patrol, 500 5th Ave., New York 18, N.Y., W.

Civil Aeronautics Journal, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

Contact, School of Aviation Medicine, U.S. Naval Air Station, Pensacola, Fla., Q.

The Department of State Bulletin, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $2.75.

Domestic Commerce, U.S. Govt. Printing Office, Washington 25, D. C., M, $0.10, $1.00.

Foreign Air News Digest, Air Transport Information Division, Economic Bureau, Civil Aeronautics Board, Washington 25, D.C., BW.

Foreign Commerce Weekly, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $4.50.

Gt. Brit., Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., Irreg.

Gt. Brit., Air Ministry, Library, Additions List, The Librarian, Whitehall, London, S.W.1, M.

Gt. Brit., Air Registration Board, Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft, Brettenham House, Strand, London, W.C.2, Irreg.

Gt. Brit., Ministry of Aircraft Production, Abstracts from the Scientific and Technical Press, and Titles and References of Articles and Papers Selected from Publications (Reviewed by R.T.P. 3), Together with List of Selected Translations, The Royal Aeronautical Society, 4, Hamilton Place, London, W.1, M.

Gt. Brit., Ministry of Aircraft Production, Translations, The Secretary (R.T.P. 3), Millbank, London, S.W.1, M.

Gt. Brit., Stationery Office, Government Publications, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M.

Index Aeronauticus, The Secretary (R.T.P. 3), Ministry of Aircraft Production, Millbank, London, S.W.1, M, 1*s*. per issue.

Journal of Research of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.30, $3.50.

List of Selected United States Government Publications, U.S. Govt. Printing Office, Washington 25, D.C., SM.

Log of Navigation, Army Air Forces, Ellington Field, Texas, M, $0.25, $3.00.

México, Departamento de Aeronáutica Civil, Publicación, Mexico, D.F., M.

Monthly Weather Review, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Myśl Lotnicza, Headquarters, Polish Air Force, Chantrey House, Eccleston St., London, S.W.1, M, 1*s*. 6*d*., 15*s*.

Production and Engineering Bulletin, British Supply Council in North America, P.O. Box 680, Benjamin Franklin Sta., Washington 4, D.C., M.

Revista de la Fuerza Aérea, Ministerio de Defensa Nacional, Santiago de Chile, M.

Skrzydła, Headquarters, Polish Air Force, Chantrey House, Eccleston St., London, S.W.1, BW, 6*d*., 15*s*.

This is the twenty-third of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME

"The Creative Mind and Aviation Research"

by R. E. GILLMOR, President, Sperry Gyroscope Company, Inc.

"THE CREATIVE MIND *of man gives him supernatural powers—not only to further his own evolution, but to adapt the techniques of other creatures to his own use.*

"Engineers, for instance, are now conducting research into the gyroscopic automatic pilot of the Diptera, or two winged insects—two tiny alternating gyroscopes perfectly designed for maximum momentum with minimum weight; and a unique control system for automatically executing the orders of the nervous system. And, although man may never be able to keep within nature's specifications for space and weight, some day we can hope he will catch up with her in matters of gyroscopic design and function.

"But, while science is catching up with nature, all sorts of by-products will continue to emerge from research like this: devices that will automatically keep small private planes on their courses in all kinds of weather; devices that will compensate for treacherous air currents when helicopters land in backyards or on roof tops; pilotless cargo planes; 'trains' of cargo ships controlled by a single lead plane. Man's creative mind, through research, has hardly begun to probe the possibilities of speed and safety in flight."

● ● ●

Both the *need* for air research and the *fruits* of air research will find their strongest support in America's "test-pilot" market—the men and women who will be the first to buy and fly the planes of the postwar—people like the readers of TIME.

No fiction is this TIME "test-pilot" market. For almost half of TIME's readers fly—have already flown more than 2,000,000,000 miles . . . more than 400,000 of TIME's million subscriber-families say they hope to own a private plane of their own after the war . . . and more than 30,000 already *have a pilot's license.*

Aviation ranks TIME readers among its top postwar prospects for private planes, for business-and-pleasure air travel, for air transport and shipping. And just as TIME-minded people are air-minded, so are air-minded people TIME-minded! Wherever veteran air-travelers fly, TIME flies too. Again and again, travelers on leading airlines vote TIME their first-choice magazine by standout margins.

Believing that the ideas of aviation's leaders are always of interest to the aviation industry,
TIME here gives them wider circulation
in the name of

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

Technical Data Digest, Air Technical Service Command, TSEAL-61, Area B, Wright Field, Dayton, Ohio, M.

Technical News Bulletin of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

U.S., Army Air Forces, Air Technical Service Command, Translations, Wright Field, Dayton, Ohio, Irreg.

U.S., Army Air Forces, Technical Publications for Army Air Forces Technical Libraries, Book List, Library Branch, Washington 25, D.C., Irreg.

U.S., Army War College, Library, Abstracts of Selected Periodical Articles of Military Interest, Washington 25, D.C., M.

U.S., Civil Aeronautics Administration, Technical Development Notes, Technical Development Reports, Washington 25, D.C., Irreg.

U. S., Forest Products Laboratory, Progress Reports, Madison, Wis., Irreg.

U.S., N.A.C.A., Technical Memorandums, National Advisory Committee for Aeronautics, Washington 25, D.C., Irreg.

United States Government Publications, Monthly Catalog, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Company Publications

Aero, Aero Division, Minneapolis-Honeywell Regulator Co., 2753 4th Ave. S., Minneapolis 8, Minn., M.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Aero Research Technical Notes, Aero Research, Ltd., Duxford, Cambridge, England, M.

Aerolite, Ryan Aeronautical Co., Lindbergh Field, San Diego, Calif., W.

The Air Box, Chandler-Evans Corp., So. Meriden, Conn., BM.

The AiResearcher, AiResearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif., M.

Airflow, Academy of Aeronautics, Jackson Heights, L.I., N.Y., and Casey Jones School of Aeronautics, Newark, N.J., M.

Airport Manager's Service Bulletin, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind., SM.

Aluminum News Letter, Aluminum Co. of America, Pittsburgh 19, Pa., M.

The ASCo Aircrafter, American Stove Co., 1825 E. 40th St., Cleveland 3, Ohio, BW.

Aviation Bulletin, The British Aviation Insurance Co. Ltd., 500 Place d'Armes, Montreal, Quebec, M.

Bakelite Review, Union Carbide and Carbon Corp., 30 E. 42d St., New York 17, N. Y., Q.

The Ballardair, The Walter M. Ballard Corp., 331 Madison Ave., New York 17, N.Y., M.

The Beech Log, Beech Aircraft Corp., Wichita, Kan., W.

The Bee-Hive, United Aircraft Corp., East Hartford, Conn., BM.

Bell Aircraft News, Bell Aircraft Corp., Buffalo, N.Y., W.

Bell Aircraft News, Bell Aircraft Corp., Marietta, Ga., W.

Bell Laboratories Record, 463 West St., New York 14, N.Y., M, $2.00 yr.

The Bell Ordnance News, Bell Aircraft Corp., Burlington, Vt., W.

The Bellringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y., M.

Bendix Communiqué, Philadelphia Div., Bendix Aviation Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa., M.

Bendix Radio Engineer, Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., Q, $2.00 yr.

Between Ourselves, Trans-Canada Air Lines, 360 McGill St., Montreal, Quebec, M.

Bladesman, Propeller Div., Curtiss-Wright Corp., Caldwell, N.J., Irreg.

The B-Liner, Braniff Airways, Inc., Dallas 9, Tex., M.

Boeing Contact, Boeing Airplane Co., Wichita, Kan., M.

Boeing Magazine, Boeing Aircraft Co., Seattle, Wash., M.

Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan., W.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J., M.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W.1, M.

Bulaero, Cal-Aero Technical Institute, Glendale, Calif., M.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., Irreg.

Caminos del Aire, Pan American Airways, Inc., Bolivar 18, Mexico, D.F., M.

Canadian Car Journal, English Edition, Canadian Car & Foundry Co. Ltd., 621 Craig St., West, Montreal, Quebec, M.

Cessquire, Cessna Aircraft Co., Wichita, Kan., M.

The Chance Vought News, Chance Vought Aircraft Div., United Aircraft Corp., Stratford, Conn., SM.

Chicago Douglas Airview News, Douglas Aircraft Co., Inc., Park Ridge, Ill., W.

Circle-News, The B. F. Goodrich Co., 500 S. Main St., Akron 11, Ohio, W.

Classroom Clipper, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

The Comet, Ampco Metal, Inc., Milwaukee 4, Wis., M.

The Connecting Link, Link Aviation Devices, Inc., Binghamton, N.Y., BM.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash., BM.

The Continental Eagle, Continental Air Lines, Inc., Municipal Airport, Denver, Colo., M.

Convair News, Consolidated Vultee Aircraft Corp., Miami, Fla., W.

Curtiss Fly-Leaf, Airplane Div., Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y., BM.

Curtiss Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo., W.

Daggett Douglas Airview News, Douglas Aircraft Co., Inc., Daggett, Calif., W.

De Havilland Mosquito, de Havilland Aircraft of Canada, Ltd., Postal Sta. L, Toronto, Ontario, M.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Douglassair Foreign Letter, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Dow Diamond, The Dow Chemical Co., Midland, Mich., BM.

The Dragon, The Fafnir Bearing Co., New Britain, Conn., M.

The Eagle, Consolidated Vultee Aircraft Corp., Ft. Worth, Tex., W.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J., M.

Edo Log, Edo Aircraft Corp., College Point, L.I., N.Y., M.

Edo Weekly Log, Edo Aircraft Corp., College Point, L.I., N.Y., W.

The Educational Focus, Bausch & Lomb Optical Co., Rochester, N.Y., Q.

El Segundo Douglas Airview News, Douglas Aircraft Co., Inc., El Segundo, Calif., W.

Electrical Communication, International Standard Electric Corp., 67 Broad St., New York, N.Y., Q, $0.75, $3.00.

Ethyl News, Ethyl Corp., 405 Lexington Ave., New York 17, N.Y., M.

FAD, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Hagerstown, Md., BW.

Fairchild News, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N.Y., M.

The Fairchrafters, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Burlington, N.C., W.

Flagship World, American Airlines, Inc., 100 E. 42d St., New York 17, N.Y., BM.

Fleetwings Arrow, Fleetwings Div., Kaiser Cargo Inc., Bristol, Pa., M.

Flight Control, Bendix Aviation Corp., Teterboro, N.J., M.

The Flying M, Menasco Mfg. Co., Burbank, Calif., BW.

Franklin Facts, Aircooled Motors Corp., Liverpool Rd., Syracuse 8, N.Y., Irreg.

General Aircraft News, London Air Park, Feltham, Middlesex, England, M.

Glider Release, Laister-Kauffmann Aircraft Corp., 5660 Oakland Ave., St. Louis, Mo., M.

The Globe Beam, Globe Aircraft Corp., Fort Worth 6, Tex., M.

GM Folks, General Motors Corp., Detroit, Mich., M.

The Grace Log, W. R. Grace & Co., 7 Hanover Sq., New York 5, N.Y., Q.

Grumman Plane News, Grumman Aircraft Engineering Corp., Bethpage, N.Y., W.

Guiberson Guidon, Guiberson Corp., Dallas, Tex., BW.

The Hamilton Standard Blade, Hamilton Standard Propellers Div., United Aircraft Corp., 362 S. Main St., East Hartford, Conn., SM.

Hangar Flying, Lockheed Aircraft Corp., Burbank, Calif., M.

The Hecker Michronicle, A. W. Hecker, 1976 E. 66th St., Cleveland, Ohio, M.

The Higgins Aircrafter, Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La., W.

Hobart Arc Welding News, The Hobart Bros. Co., Troy, Ohio, Irreg.

Hughesnews, Hughes Aircraft Co., Florence at Teale Sts., Culver City, Calif., SM.

Inco, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., Q.

Instrumentation, The Brown Instrument Co. Div., Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa., BM.

The Intava World, International Aviation Associates, Artillery House, Artillery Row, London, S.W.1, M.

Interstate-ments, Interstate Aircraft and Engineering Corp., 641 S. Oxford Ave., Los Angeles, 5, Calif., SM.

The Jahco News, Jack & Heintz, Inc., Solon Rd., Bedford, Ohio, M.

Kellett News, Kellett Aircraft Corp., 58th & Grays Ave., Philadelphia 43, Pa., SM.

Kidde Industry, Walter Kidde & Co., Inc., 140 Cedar St., New York 6, N.Y., BM.

The Kinner Log, Kinner Motors, Inc., 635 W. Colorado Blvd., Glendale 4, Calif., M.

The Kollsman Instrument Dial, Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., M.

Kollsman Pointers, Engineering Dept., Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., BM.

The Lear Log, Lear Incorporated, Piqua, Ohio, M.

Lockheed Cross and Crown, Lockheed Christian Fellowship, Inc., Roscoe 3, Calif., M.

Lockheed Log, Lockheed Aircraft Corp., Burbank, Calif., Q.

The Lockheed Star, Lockheed Aircraft Corp., Burbank, Calif., W.

Long Beach Douglas Airview News, Douglas Aircraft Co., Inc., Long Beach, Calif., W.

Lubrication, The Texas Co., 135 E. 42d St., New York 17, N.Y., M.

Lukens Steel Co., Technical Library, Bulletin, 1940 Gillen St., Coatesville, Pa., M.

The Lycoming Star, Lycoming Div., The Aviation Corp., Williamsport, Pa., M.

McDonnell Bulletin, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo., W.

The Martin Star, The Glenn L. Martin Co., Baltimore 3, Md., M.

Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Metco News, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y., BM.

New Horizons, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

News Digest, Hill and Knowlton, 350 5th Ave., New York 1, N.Y., W.

Nickel Cast Iron News, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Nickel Steel Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Noorduyn Tale-Spin, Noorduyn Aviation Ltd., 1411 Crescent St., Montreal, Quebec, M.

North American Skyline, North American Aviation, Inc., Inglewood, Calif., BM.

North American Skywriter, North American Aviation, Inc., Inglewood, Calif., W.

North Ameri-Kansan, North American Aviation, Inc., of Kansas, Kansas City, Kan., W.

Northeast Airlines Gremlin, Northeast Airlines, Inc., 1 State St., Boston, Mass., Q.

The Northeast Airlines Up-to-the-Minute Man, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass., D.

The Northrop News, Northrop Aircraft, Inc., Northrop Field, Hawthorne, Calif., BW.

Oklahoma City Douglas Airview News, Douglas Aircraft Co., Inc., Oklahoma City, Okla., W.

Oscillator, Western Electric Co., 195 Broadway, New York, N.Y., Irreg.

PCA News, Pennsylvania-Central Airlines, Washington National Airport, Washington 25, D.C., M.

Pan Atlantic News, Atlantic Div., Pan American World Airways, La Guardia Field, New York, N.Y., W.

Parks Air News, Parks Air College, E. St. Louis, Ill., M.

The Pegasus, Fairchild Engine & Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y., M.

Pesco Pilot, Pesco Products Co. Div., Borg-Warner, 11610 Euclid Ave., Cleveland 6, Ohio, M.

The Pick-Up, All American Aviation, Inc., 209 W. 9th St., Wilmington, Del., M.

Plane Talk, Consolidated Vultee Aircraft Corp., Room 3301, 350 5th Ave., New York 1, N.Y., M.

Plastics Bulletin, Plastics Department, E. I. du Pont de Nemours & Co. (Inc.), Arlington, N.J., Irreg.

Profilometer Comments, Physicists Research Co., 343 S. Main St., Ann Arbor, Mich., Irreg.

Ranger's Cloud Buster, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp., Farmingdale, L.I., N.Y., SM.

What will the Air World be like?

Thanks to the aviation industry, it will be a small world. The airplane, spanning the globe in regular, daily commercial flights—no matter what the weather—can make "good neighbors" of all nations. Encouraging air travel is the job not only of the aircraft industry, but also of the makers of communications and other electronic equipment for use in aviation. And there you'll find Western Electric still leading the way.

During the Seventh War Loan Drive, buy bigger, extra War Bonds!

Western Electric

Distributed by GraybaR

RADIO AND OTHER ELECTRONIC EQUIPMENT FOR A WORLD ON WINGS

The Resinous Reporter, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., M.

The Rohm & Haas Reporter, Rohm & Haas Co., 222 W. Washington Sq., Philadelphia 5, Pa., M.

Rotol Digest, Reference Library, Rotol, Ltd., Gloucester, England, W.

Ryan Flying Reporter, Ryan Aeronautical Co., San Diego, Calif., M.

Ryan Sky News, The Ryan School of Aeronautics, Lindbergh Field, San Diego, Calif., M.

Santa Monica Douglas Airview News, Douglas Aircraft Co., Inc., Santa Monica, Calif., W.

Service Engineering, Kent-Moore Organization, 485 W. Milwaukee Ave., Detroit, Mich., Irreg.

Shell News, Shell Progress, Shell Oil Co., Inc., 50 W. 50th St., New York 20, N.Y., M.

Simmonds Aeronews, Simmonds Aerocessories, Inc., 21-10 49th Ave., Long Island City, N.Y., BW.

Skyfarer, General Aircraft Corp., 43-02 Ditmars Blvd., Long Island City 5, N.Y., BW.

The Skyliner, Transcontinental & Western Air, Inc., Kansas City, Mo., M.

Sky Steps, Chicago and Southern Air Lines, Municipal Airport, Memphis 2, Tenn., M.

The Southernaire, Southern Airways, Inc., 400 Trust Co. of Georgia Bldg., Atlanta 3, Ga., M.

Spartan News, Spartan School of Aeronautics and Spartan Aircraft Co., Municipal Airport, Tulsa, Okla., M.

Speed, Western Air Lines, Inc., 510 W. 6th St., Los Angeles, Calif., M.

The Sperry News, Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn 1, N.Y., SM.

Sperryscope, The Sperry Corp., Manhattan Bridge Plaza, Brooklyn 1, N.Y., Q.

The Stabilizer, The Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland 1, Ohio, BM.

The Stabilizer, Schweizer Aircraft Corp., County Airport, Elmira, N.Y., W.

Steel Horizons, Allegheny Ludlum Steel Corp., Brackenridge, Pa., Irreg.

The Stinsonair, Stinson Div., Consolidated Vultee Aircraft Corp., Wayne, Mich., BW.

Take-Off, North American Aviation, Inc., Dallas, Tex., W.

The Taylorcraft News, Taylorcraft Aviation Corp., Alliance, Ohio, M.

Technical Education News, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Technograph, The Glenn L. Martin Co., Baltimore 3, Md.

The Texaco Star, The Texas Co., 135 E. 42d St., New York 17, N.Y., Q.

The Timmcrafter, Timm Aircraft Corp., 7801 Hayvenhurst Ave., Van Nuys, Calif., M.

Trade Winds, Wright Aeronautical Corp., Paterson, N.J., BM.

Transatlantic Air News, American Export Airlines, 25 Broadway, New York 4, N.Y., M.

Tulsa Douglas Airview News, Douglas Aircraft Co., Inc., Tulsa, Okla., W.

United Air Lines News, United Air Lines, Inc., 5959 S. Cicero Ave., Chicago 38, Ill., M.

U. S. Steel News, United States Steel Corp. of Delaware, 436 7th Ave., Pittsburgh, Pa., Q.

US, United States Rubber Co., 1230 6th Ave., New York 20, N.Y., M.

The Valve, Wilcox-Rich Div., Eaton Mfg. Co., Battle Creek, Mich., M.

The Volunteer, Consolidated Vultee Aircraft Corp., Nashville Div., Nashville, Tenn., W.

The Waco Word, Waco Aircraft Co., Troy, Ohio, M.

War Production Drive, Summerill Tubing Co., Bridgeport, Montgomery County, Pa., M.

The Wasp Nest, Pratt & Whitney Aircraft Corp. of Missouri, Kansas City, Mo., M.

Westinghouse Newsfront, Westinghouse Electric Corp., 306 4th Ave., Pittsburgh 30, Pa., M.

Wheelco Comments, Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill., BM.

Wing Tips, Mid-Continent Airlines, Inc., Waltower Bldg., Kansas City, Mo., M.

The Wingfoot Clan, Aircraft Edition, Goodyear Aircraft Corp., 1210 Massilon Rd., Akron 15, Ohio, W.

The Wingfoot Clan, Arizona Edition, Goodyear Aircraft Corp., Litchfield Park, Ariz., W.

Wright at the Moment, Wright Aeronautical Corp., Paterson, N.J., W.

Army and Navy Post Newspapers

The AAFSATONIAN, School of Applied Tactics, Army Air Forces, Orlando, Fla., W.

The Ace-Pursuiter, Special Service Office, Paine Field, Everett, Wash., SM.

Aero Time, Basic Flying School, Army Air Forces, Gunter Field, Ala., W.

Air Base News, Army Air Base, Jackson, Miss., W.

Air Currents, Army Air Field, Coffeyville, Kan., W.

The Aircraft Warning Volunteer, First Fighter Command, Army Air Forces, Mitchel Field, N.Y., M.

Air-O-Mech, Army Air Forces, Seymour Johnson Field, N.C., W.

The Air-Scoop, Army Air Base, Pueblo, Colo., W.

Alamogordo Blockbuster, Army Air Base, Alamogordo, N.M., W.

AM, Army Air Field, Lincoln, Neb., W.

Army Wives Informer, Officers' Mess, HQ, 4th Air Force, Hamilton Field, Calif., M.

Barksdale's Bark, Army Air Forces, Barksdale Field, La., W.

The Beach Post, Training Center No. 1, Army Air Forces, Miami Beach, Fla., W.

The Beam, Pilot School (Advanced Single Engine), Army Air Forces, Army Air Field, Marianna, Fla., W.

The Beam, Special Service Office, Army Air Forces, Bolling Field, D.C., SM.

Biggstuff, Army Air Forces, Biggs Field, Tex., W.

Black Landmarks, Blackland Army Air Field, Waco, Tex., W.

The Block Buster, Army Air Field, Gulfport, Kan., M.

The Bomb Bay, Army Air Forces, Hammer Field, Fresno, Calif., W, $2.00 yr.

Bomb Blast, Army Air Field, Childress, Tex., W.

Bombing Range High Score, Army Air Forces, Avon Park, Fla., W.

Bombs Away, Army Air Field, Victorville, Calif., SM.

The Bombsight, Advanced Flying School, Army Air Forces, Kirtland Field, N.M., W.

Booster, Pilot School (Advanced Single Engine), Army Air Forces, Napier Field, Dothan, Ala., W.

Boot Hill Marauder, Army Air Field, Dodge City, Kan., W.

The Bradley Beam, Army Air Forces, Bradley Field, Conn., W.

The Cactus, Army Air Field, Kingman, Ariz., W.

The Carrier, Army Air Forces, Bowman Field, Louisville, Ky., W.

Casual Observer, Army Air Field, Lemoore, Calif., W.

Command Post, Air Service Command, McClellan Field, Sacramento, Calif., W.

Craig Field Journal, Pilot School (Advanced Single Engine), Army Air Forces, Craig Field, Selma, Ala., W.

The Dalhart Buzzer, Army Air Field, Dalhart, Tex., W.

Del Valle News, Bergstrom Army Air Field, Austin, Tex., W.

Drew Field Echoes, Army Air Base, Drew Field, Tampa, Fla., W.

The Eagle Eye, Eagle Pass Army Air Field, Eagle Pass, Tex., W.

Enid Plane Facts, Enid Army Flying School, Enid, Okla., W.

The Fighter Pilot, Army Air Field, Pocatello, Idaho, W.

Flexigun, Flexible Gunnery School, Army Air Forces, Ft. Myers, Fla., M.

The Flight Pattern, Army Air Field, Douglas, Ariz., SM.

Flight Time, Basic Pilot School, Army Air Forces, Goodfellow Field, Tex., W.

Flyer, Army Air Base, Reno, Nev., W.

The Flyer, Army Air Field, Chico, Calif., W.

Flying Time, Pilot School (Basic), Army Air Forces, Pecos, Tex., W.

Flying Time, South Plains Army Air Field, Lubbock, Tex., W.

Foster Field Fighter, Army Air Forces, Foster Field, Tex., M.

The Greenville Post, Army Air Field, Greenville, Miss., W.

The Greenwood Gremlin, Pilot School (Basic), Army Air Forces, Greenwood, Miss., W.

The Gunner's Post, Flexible Gunnery School, Army Air Forces, Harlingen, Tex., W.

Hamilton Field Takeoff, Army Air Forces, Hamilton Field, Calif., M.

Hawk's Cry, Army Air Field, Tuskegee, Ala., W.

Jefferson Barracks Hub, Air Forces Basic Training Center, Jefferson Barracks, Mo., W.

The Keesler Field News, Eastern Technical Training Command, Army Air Forces, Biloxi, Miss., W.

Lille Norge Avisen, Training Centre, Royal Norwegian Air Force, 341 Church St., Toronto, M.

The Lockbourne Air Base News, Lockbourne Army Air Base, Columbus, Ohio, W.

The Lukominique, Army Air Forces, Luke Field, Ariz., W.

The M.A.A.F. Cowling, Marana Army Air Field, Tucson, Ariz., SM.

The March Field Beacon, Army Air Forces, March Field, Calif., W.

Marfacts, Pilot School (Advanced Two Engine), Army Air Forces, Marfa, Tex., W.

NAAF News, Army Air Field, Newport, Ark., SM.

News, Army Air Field, Presque Isle, Me., W.

The Northern Dispatch, Army Air Base, Great Falls, Mont., W.

Notam, Army Air Base, Daniel Field, Augusta, Ga., W.

The ORD News, Army Air Forces Training Command, Greensboro, N.C., W.

The Pilot, Army Air Field, La Junta, Calif., W.

The Pilot, Army Air Field, Walnut Ridge, Ark., W.

The Polar Tech, The Argus-Leader Co., Sioux Falls, S.D., W.

Prairie Flier, Strother Army Air Field, Winfield, Kan., W.

The Randolph Rookie, Army Air Forces, Randolph Field, Tex., W.

The Reflector, Army Air Base, Richmond, Va., W, $2.00 yr.

The Reporter, Published for the Personnel of the Eastern District, Air Technical Service Command, by Aero Digest, 515 Madison Ave., New York 22, N.Y., SM.

The Rev Meter, Army Air Forces, Lowry Field, Denver, Colo., W.

The Robins Field News-Beacon, Warner Robins Air Service Command, Robins Field, Ga., W.

Roger, 6th Ferrying Group, Air Transport Command, Army Air Field, Long Beach, Calif., W.

The Runway, Army Air Forces, Pope Field, Ft. Bragg, N.C., SM.

Runway Review, Army Air Field, McCook, Nebr., W.

The Salt Tablet, Army Air Base, Wendover Field, Utah, W.

Salvo, Army Air Base, Roswell, N.M., W.

Selfridge Field News, Army Air Forces, Selfridge Field, Ala., SM.

Shorelines, Redistribution Center, Army Air Forces, Santa Monica, Calif., W.

Skyscrapers, U.S. Naval Air Station, Floyd Bennett Field, Brooklyn, N.Y., W.

The Slip Stream, Army Air Base, Casper, Wyo., W.

SNAFU, Eastern Flying Training Command, Army Air Forces, George Field, Ill., W, $0.05 per issue.

Snaproll, Pilot School (Basic), Army Air Forces, Minter Field, Bakersfield, Calif., Irreg.

Snowball, 1380th AAF Base Unit, North Atlantic Division, Air Transport Command, Presque Isle, Me., W.

Sololand, Lodwick School of Aeronautics, Inc., Lakeland, Fla., SM.

Tac Tactical Center, Army Air Forces, Orlando, Fla., W.

Tail Skid, Army Air Forces, Lawson Field, Ga., W.

Tailspin, Army Air Forces, Ellington Field, Houston, Tex., W.

The Tail-Spinner, Army Air Forces Preflight School, San Antonio, Tex., W.

Take-Off, Farris Publishing Co., Tinker Field, Okla., W.

TARFU, Laughlin Army Air Field, Del Rio, Tex., W.

The Tarranter, Army Air Field, Ft. Worth, Tex., W.

Texacts, Army Air Forces Technical School, Sheppard Field, Tex., W.

Thunderbird, The Rapid City Journal, Rapid City, S.D., W.

Torque Tattle, Army Air Forces, Cochran Field, Ga., W.

True Drift, Army Air Forces, Selman Field, La., W.

The Twin Prop, Pilot School (Advanced Two Engine), Army Air Forces, Stockton Field, Calif., W.

Twingine Times, Pilot School (Advanced Twin Engine), Freeman Army Air Field, Seymour, Ind., W.

Upcheck, Lewis School of Aeronautics, Lockport, Ill., M, $3.00.

Vox Prop, Air Service Command, Army Air Field, Rome, N.Y., W.

Williams Field Airfax, Army Air Forces, Williams Field, Chandler, Ariz., W.

Wing Tips, Pilot School (Specialized Two Engine), Mather Field, Sacramento, Calif., W.

Wingspread, Army Air Forces, Peterson Field, Colorado Springs, Colo., W.

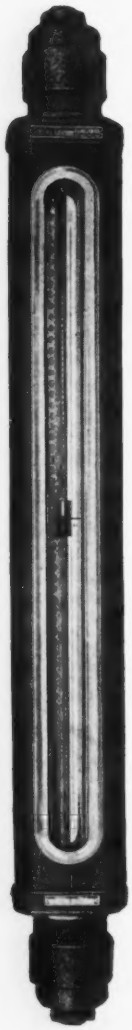
Wing-Tips, Waco Army Flying School, Waco, Tex., W.

Yuma Actioneer, Army Air Field, Yuma, Ariz., W.

Zoom, Basic Flying School, Army Air Forces, Bainbridge, Ga., W.

...for Jet PROPULSION

The Stabl-Vis Rotameter will measure liquid fuels independently of viscosity and density changes!



The Master Enclosed Test Accuracy Rotameter with 600 millimeter scale length and Stabl-Vis float for precise flow rate measurement.

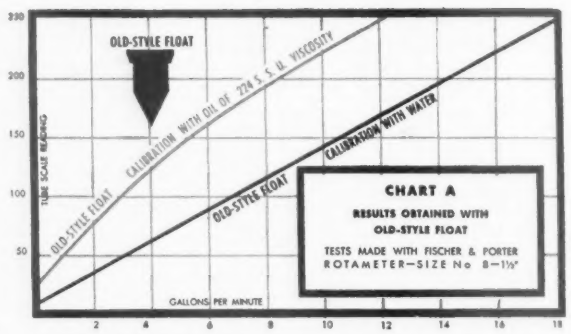
THE problem of measuring fuel flow rates to gas turbines for jet propulsion presents very serious difficulties. Changes in physical composition or temperature of the fuel cause wide variations in its viscosity and density. Fortunately, the Stabl-Vis rotameter will compensate for these variables and enable you to obtain accurate fuel flow rate measuring when checking gas turbine performance on the ground or in the air.

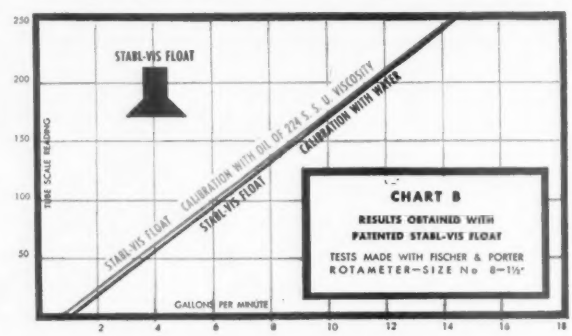
The correction which the Stabl-Vis meter gives for viscosity variations is well illustrated in Charts A and B. Chart A shows that with an old style plumb-bob rotameter float an error of 33 per cent is obtained in the rotameter calibration when the viscosity changes from 31 S.S.U. (water) to 224 S.S.U. (oil). Chart B shows the same fluids when metered in a rotameter having our patented Ultra Stabl-Vis float. The two curves superimpose one on the other, proving that the Ultra Stabl-Vis float has stabilized the rotameter calibration against viscosity variations.

This remarkable result is obtained by means of the umbrella or cup-shaped head of the Ultra Stabl-Vis float, which is illustrated in Chart B. This particular shape creates high form drag and changes sinuous flow into turbulent flow, thereby reducing skin friction of the fluid on the float surface to a minimum. The effect of viscosity on the float is neutralized so that the meter will cover a wide viscosity range without departing from its original calibration.

Density variations are overcome by our Plasmet float, which is a combination of plastic and metal in the right amounts to make the float density just twice the fluid density. When metering in weight units, the Plasmet float then compensates for fluid density variations. This phenomenon is mathematically explained in our Catalog 98-Y, an authoritative treatise on the theory of the rotameter.

Consequently, the Stabl-Vis rotameter with Ultra Stabl-Vis Plasmet float gives the Aviation Industry an accurate flow rate measuring device for liquid fuels in testing aviation engines, gas turbines, lubricating oil flows, hydraulic systems, coolants, de-icer fluids, etc. It is equally effective for gas flows to oxygen systems, air flow measurement, carbon dioxide and other gases used by aviation equipment manufacturers.


OLD-STYLE FLOAT
CALIBRATION WITH OIL OF 224 S. S. U. VISCOSITY
CALIBRATION WITH WATER
OLD-STYLE FLOAT
OLD-STYLE FLOAT
TUBE SCALE READING
GALLONS PER MINUTE
CHART A
RESULTS OBTAINED WITH OLD-STYLE FLOAT
TESTS MADE WITH FISCHER & PORTER ROTAMETER—SIZE No 8—1½"


STABL-VIS FLOAT
CALIBRATION WITH OIL OF 224 S. S. U. VISCOSITY
CALIBRATION WITH WATER
STABL-VIS FLOAT
STABL-VIS FLOAT
TUBE SCALE READING
GALLONS PER MINUTE
CHART B
RESULTS OBTAINED WITH PATENTED STABL-VIS FLOAT
TESTS MADE WITH FISCHER & PORTER ROTAMETER—SIZE No 8—1½"

For ground installations, the Stabl-Vis rotameter is built as an *indicating* meter or as a remote reading instrument that gives a *chart record* or *automatic flow control* or *flow totalization*, or as any combination of these four forms. For plane installation, the Stabl-Vis rotameter is available as an *indicating* meter or as our "Tele-Flo" *remote reading* aircraft meter.

The universal acceptance of the Stabl-Vis rotameter by the leading aviation manufacturers is your guarantee that it is the most modern, most consistently accurate flow rate measuring instrument obtainable.

The theory of the Stabl-Vis rotameter is thoroughly discussed in our Catalog 98-Y, and its practical applications for aviation purposes are carefully described and well-illustrated in Catalog 63-G. You may learn more about the best in flow rate measurement by studying these bulletins—they are free without obligation.

FISCHER & PORTER CO.
6106 County Line Road, Hatboro, Pa.

Fischer & Porter Company has pioneered EVERY basic rotameter improvement!

Air Power for Peace

Eugene E. Wilson

Contents: Air Power; Principles of War; Air Force in the First World War; Interim Air Policies; Civil Aviation; Aircraft Industry; Tactics and Strategy; Prelude to War; Air Force and Ground Forces; Air Force and Seaborne Forces; Air Force and War; Air Power and Peace.

With his long experience in the Navy and the aircraft industry Mr. Wilson's observations on air power will command respect and careful consideration. His concept of air power comprises Air Force, Air Commerce, and the Aircraft Industry, integrated and mutually interdependent.

After a review of the background development of aviation, from the industrial and governmental standpoints, the new tactics and strategy of the Air Forces are discussed. The many campaigns of World War II are analyzed with special reference to the employment of military and naval air forces.

To maintain the peace five objectives must be attained: (1) Strong military and naval air forces must be maintained. (2) An adequate aircraft industry should be based on technical leadership. (3) Foreign and domestic air commerce should be fostered. (4) Airports, airways, and aids to navigation should be expanded. (5) Young people should be encouraged to acquire the spirit and tradition of aviation.

Leadership in the air should be no physical burden but rather an investment. Possession of the greatest air power imposes major responsibility for world peace. McGraw-Hill Book Company, Inc., New York, 1945; 184 pages, $2.00.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Book Notes

Science To-day and Tomorrow, by Waldemar Kaempffert; The Viking Press, New York, 1945; 279 pages, $2.75.

The dean of science writers in this country reviews the progress made in invention and technologic development and peers into the future in this second series of his observations on the advances made by the sciences. Interspersed are his considerations of the future of air transport and stratospheric exploration, with one chapter given to rockets.

He proposes the creation of a World Scientific Commission that would map progress of scientific research and point out gaps that should be filled.

The development of science and technology has been so rapid as a result of the war that some of the articles in the first edition of the book have been omitted. Some of those retained have been revised in the light of recent advances. More than half of the second series comprises new material recording the influence of the war on research and industry and the social effects of science. The book is not only a careful survey of what has been accomplished but it presents challenges for future investigation and experimentation.

British Aircraft, Volumes I and II, by R. A. Saville-Sneath; Penguin Books, Hammondsworth, Middlesex, England, 1944; 224 pages each, 5*s.* each.

These two books provide a comprehensive review of British aircraft built during the past 10 years. Not only are the characteristics and principal specifications given, but text, drawings, and photographs accentuate the recognition features.

The first volume describes monoplane landplanes. The second reviews biplane landplanes, seaplanes, amphibians, gliders, rotating wing aircraft, jet propulsion aircraft, airships, and aircraft engines. It will be seen that the coverage is broad and gives all that the engineer may wish to know in general about a special type.

Pictorially the books are excellent, many of the photographs being reproduced in gravure. The popularity of the two volumes early made them unavailable at book shops but at those libraries that are fortunate in securing copies they will serve as useful references.

Masters of Mass Production, by Christy Borth; The Bobbs-Merrill Company, New York, 1945; 290 pages, $3.50.

This timely book reviews the development of mass production in the United States. Starting with the work of early inventors, such as Paul Revere and Eli Whitney, it shows how this technique has been used in the automotive and other industries. The life stories of some of the outstanding production leaders, such as Knudsen, Sorensen, Kaiser, and Girdler are sketched.

How mass production was applied to the aviation industry is described, with particular emphasis on the achievements of the Consolidated Vultee Aircraft Corporation and Ford Motor Company. The successes of Douglas, Fleet, Kindleberger, Gross, and others in the use of mass production for the fabrication of airplanes are outlined.

The book is an inspiring record of manufacture in which the United States has been a pioneer, the effect of which on the war effort is apparent from the many uses to which this procedure has been applied.

Army Day Review 1945; Army Day Committee, Washington, 1945; 366 pages, $0.50.

This paper-bound book, issued by the Army Day Committee of the Military Order of the World Wars, which sponsors Army Day, gives a broad presentation of the Army forces in peace and in combat. It contains essentially the story of the operations and successes of the Army from the beginning of 1944 through the early months of 1945.

It contains photographs and short sketches of the leading military and naval officers of the United States, followed by articles about each branch of the Army. It is well illustrated and as a general review of the war will serve as an excellent reference.

Wrought Steels (Carbon and Alloy Steels); prepared by the Technical Advisory Committee of the Special and Alloy Steels Committee (Steel Control of the Ministry of Supply); The British Standards Institution, London, 1944; 98 pages, 7*s.* 6*d.*

Revisions to September, 1944, are included in a new Technical Advisory Committee schedule of specifications for special and alloy steels for aircraft and other uses, designated as *B.S. 971, 1944,* complementary to *B.S. 970, 1942.* After an explanatory foreword giving the details of the revisions and modifications of earlier schedules, the book contains a

THE KELLETT XR-8 HELICOPTER

Just released by the Army Air Forces, this photograph illustrates a new product whose evolution toward important peace-time achievements has been stimulated by the urgency of war.

The XR-8 is the first American helicopter successfully tested in flight to embody the principle of an *intermeshing twin set* of rotor blades. Structural vibration, long an obstacle to progress in rotary-winged craft, is largely removed. Many related problems have been solved. The need for long power-transmission shafts is eliminated. Weight and drag are saved, increasing pay-load.

Its whirling "egg-beater" vanes enable the XR-8 to fly forward, backward or sidewise with unusual efficiency. Like a hummingbird, it can hover motionless in the sky, or only a few feet above ground. Its vertical take-off and descent permit operation to or from any space that gives safe clearance to the sweep of its own blades.

With sixteen years of design and engineering experience in autogiro and helicopter development, the Kellett organization believes that helicopters will perform a wide range of useful jobs in the new air world of tomorrow.

"Answering Some Helicopter Questions" gives interesting facts about "wingless flight." For free copy, write to Kellett Aircraft Corporation, Dept. **B,** Upper Darby (Philadelphia), Pa.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

classification of the steels, the recommended and alternative schedule of steels, and commentaries upon each of the grades of steel included in the schedules. These commentaries give figures actually obtained in practical work. The schedules for bars, billets, stampings, and light forgings give the chemical composition of the material and some of its physical specifications and applications.

Astronomical Navigation Without Mathematics, by Lt. Col. A. L. Mieville; The Macmillan Company, New York, 1945; 25 pages, $0.65.

A method of navigation is outlined in which calculations are reduced to a single sum of addition. Two known stars are the basis for finding the position but, while the principles set forth are those upon which the usual mathematical processes are based, no mathematics, formulas, or alternate methods of "position" finding are required. It is reported that this navigational scheme is not new but has been in use since before the first World War.

Excess Profits Tax Relief: The Cyclical Provisions, by Joseph L. Snider; Harvard University, Graduate School of Business Administration, Division of Research, Boston, 1944; 30 pages, $1.50.

No. 33 in the Harvard University Business Research series, this pamphlet is concerned with the application of the cyclical provisions for excess profits tax relief (Section 722 of the Internal Revenue Code) to the specific situations of individual taxpayers. The report consists of two principal parts and a statistical appendix. Part I discusses in detail two actual relief claims selected from a large number examined by the author. In each instance the claim is summarized, its elements of strength and weakness are indicated, and the author's conclusions with regard to its merits are offered. Part II deals directly with the principal issues involved in the application of the cyclical provisions of Section 722, utilizing in part the evidence built up in the examination of the two specific cases and especially the material developed in the appendix.

The Municipal Airport in the National Airport Program; The United States Conference of Mayors, Washington, D.C., 1945; 16 pages.

In this booklet statistical and other information is given about the role that municipalities will play in the national airport reconstruction program. Sections are devoted to airports for national defense, postal service, commercial transportation, and private flying. The part airports will play in national employment is also discussed.

Directory of Colleges, Universities and Professional Schools Offering Training in Professions Other Than Those Concerned with Health and the Arts, compiled by Claire B. Benenson; Institute of Women's Professional Relations, New London, Conn., 1944; 550 pages, $2.00.

This is a list of institutions that offer specialized training for women. The schools offering training in each occupation are listed geographically by states. Information relative to entrance requirements, length of course, degrees granted, tuition and fees, living expenses, fellowships, and loan funds available are given for each institution.

Analysis and Design of Airplane Structures, by E. F. Bruhn; Tri-State Offset Company, Cincinnati, 1943; various paging, $4.50.

In this latest edition of a book on the structural design of aircraft, a few revisions have been made in Chapter C2 "Practical Design of Steel and Aluminum Tubes as Column and Tension Members," based on the latest recommendations of ANC-5, (Revision of 1942). Chapter C11, "Bulkhead and Frame Analysis," added in the second printing of the book, is continued without change.

Global Epidemiology, by James Stevens Simmons, Tom F. Whayne, Gaylord West Anderson, and Harold Maclachlan Horack; J. B. Lippincott Company, Philadelphia, 1944; 504 pages, $7.00.

Based on surveys made for the Medical Department of the U.S. Army, this book contains information regarding the medical, health, and sanitary conditions of various geographic areas of the world.

It is divided into two parts: one investigating the geography and climate, public health, medical facilities, and diseases of India and the Far East; the other concerned with the same data for countries of the Pacific Area. Part I contains chapters on Burma, Ceylon, China, Formosa, French Indo-China, India, Japan, Korea, British Malaya, Nampo Islands and Ryukyu Islands and Thailand. In Part II the health and sanitation conditions of the following are discussed: Australia, Cook Islands and Niue Island; Easter Island; Fiji Islands; French Oceania; Gilbert, Ellice, Ocean, and Nauru Islands; Guam; Territory of Hawaii; Japanese Mandated Islands; Johnston Island and Northern Line Islands; Netherlands East Indies; New Caledonia; New Hebrides; New Zealand; North Borneo, Sarawak, and Brunei; Papua, New Guinea, and the Bismarck Archipelago; Philippine Islands; Phoenix Islands; Pitcairn Island; Samoa Islands; British Solomon Islands; Tokelau or Union Islands; Tonga or Friendly Islands. A group of maps illustrates world distribution of the principal tropical diseases.

Universal Decimal Classification; Volume 2, Part I, 103 pages; Volume 2, Part II, 77 pages; British Standards Institution, London, 1943; 10*s.* each.

Parts I and II of Volume 2 of a revised English edition of the *Universal Decimal Classification* was published by the British Standards Institution at the joint request of the British Society for International Bibliography and the Association of Special Libraries and Information Bureaus and with the approval of the publishers of the *Dewey Decimal Classification.* The Universal Decimal Classification is an extension of the Decimal classification originated by Melvil Dewey and has been prepared by the Fédération Internationale de Documentation with the collaboration of leading specialists in many countries. Editions in French and German have already been published under the auspices of the F.I.D. The Universal Decimal Classification has been adopted by the International Federation of the National Standardization Associations for the classification of its documents.

These books are made available for the use of bibliographic workers and others, including the classification of books and articles in libraries, of abstracts of scientific papers, and of lists of references to published literature.

Ground Instructor Rating, by Charles A. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1944; 192 pages, $3.00.

The third and revised edition of a text for candidates for the Ground Instructor rating contains an enlarged chapter about methods of teaching. The text emphasizes the five principal subjects on which the applicant is to be examined: navigation, meteorology, the airplane and aerodynamics, aircraft power plants and the Civil Air Regulations. It is intended to prepare the applicant for the multiple-choice type of examination and to pass an oral examination concerned with methods of instruction and classroom work.

Air Navigation: Part VI, Contact Flying, published under the supervision of the Aviation Training Division, Office of the Chief of Naval Operations; McGraw-Hill Book Company, Inc., New York, 1945; 182 pages, $2.50.

The elements of contact navigation are dealt with in this manual, which is Part VI of a flight-preparation series. Sections are devoted to flight technique, navigation procedure, and map reading. An outline is given of Civil Aeronautics Administration regulations that govern cross-country flights within the United States. The manual has been prepared to meet the special needs of the U.S. Navy's Aviation Training Program in wartime.

Legal Rules for International Aviation, by Charles S. Rhyne; Reprinted from *Virginia Law Review,* March, 1945; pages 267–315.

International air law, which has been created by conventions and agreements as applied by the courts, is reviewed. The study collects in one place the foundations on which the legal rules for international aviation operations of the future must be erected. In the last section of the booklet the results of the International Civil Aviation Conference held at Chicago in November and December of 1944 are reviewed.

In tomorrow's luxury sky-liners

LESS DEADWEIGHT
with
Skydyne
SANDWICH CONSTRUCTION
for partitions, flooring and all other interior equipment

You actually save hundreds of pounds per plane when you use Skydyne airborne equipment. For the famous Skydyne Sandwich Construction combines less weight with greater strength than is possible by any other process. Skydyne is the perfect solution for the smart, streamlined passenger accommodations and airborne equipment now on your drawing board.

RESISTS SOUND . . . HEAT . . . VIBRATION

Form-molded on a balsa, cork or light synthetic material, Skydyne is laminated with aluminum, fibre glass, papreg, plywood or other facing material—giving a smooth, attractive, rivet-free surface. Complex shapes and curvatures are readily attained, and Skydyne's high resistance to transfer of heat, cold, vibration and sound is of special importance in luxury plane construction.

LIGHTER, STRONGER PLANE COMPONENTS

Skydyne aeronautical engineers pioneered the Sandwich Construction for aircraft surfaces—as well as for all interior equipment. They will be glad to confer with you at any time on your specific problems — and to help you BUILD LIGHTER PLANES . . . FOR LARGER PAYLOADS . . . WITH SKYDYNE!

WRITE FOR THIS BOOKLET
describing many uses for Skydyne Sandwich Construction.

Skydyne Inc
PORT JERVIS, NEW YORK

RAAF Saga, prepared by R.A.A.F. Directorate of Public Relations; Australian War Memorial, Canberra, 1944; 200 pages, 7*s.* 6*d.*

This is a companion book to the earlier *RAAF Log* and relates personal stories of combat by pilots of the Royal Australian Air Force.

Since Australian air forces were engaged in almost all areas where air fighting occurred, the scope of the book covers the war on all fronts. The valor and heroism of the fighting man from "down under" is well known, and these intimate accounts written in the first person confirm what is generally recognized.

The book is a saga of heroism and an addition to the traditional record of the bravery of Australian pilots and their crews.

Science Year Book of 1945, edited by John D. Ratcliff; Doubleday, Doran and Company, Inc., Garden City, N.Y., 1945; 224 pages, $2.50.

The fourth annual volume of this series again chooses articles written during the year on scientific subjects, selected for their general interest.

The section on aviation has articles on the airplanes of the future, rockets, the gas turbine, "buzz" bombs, and research regarding high-speed flight. All are written for popular reading, and, like the other articles that are reprinted, give a prophetic view of the future in many branches of science.

Famous American Naval Officers, by Charles Lee Lewis; L. C. Page & Company, Inc., Boston, 1945; 415 pages, $2.75.

The United States Navy has traditions that affect every officer. This book relates the deeds of those officers who have made many of those traditions pass in review and their contributions to naval history are summarized.

The only officer of the present war given a place in the book is Admiral Ernest J. King. His biography is used to review the work of the Navy in this war. The effect of air power is shown but it will require additional biographies in a later edition to assure this new element of air warfare its proper place in naval strategy.

The World System of Decimal Weights, Measures, Graduation, and Time, by Hamar; Universal Unit Systems, Inc., New York, 1945; 69 pages, $1.25.

Details are given about a proposed world system that comprises four systems of division of units for measuring purposes, namely, weights, measures, graduation, and time, and places them on a common decimal basis.

Survival; The Infantry Journal, Washington, 1944; 376 pages, $1.50.

Originally prepared and published by the Airlines War Training Institute, this is a manual for aircraft crews and other men forced down, adrift, or otherwise required to get back to help in all parts of the world. It includes suggestions about obtaining food, building shelters, traveling protection against disease,

NEW! Another GRAND Speed CLAMP
EXTRA DEEP THROAT
QUICK SETTING
INSTANT TRIGGER RELEASE

HERE IS THE EXTRA-DEEP THROATED
SPEED CLAMP
You have been asking for

GRAND A.S.L. DEEP THROAT CLAMPS

Position instantly with push-on combination ratchet screw (no waste motion running down screw) and tighten with turn of vise-type handle—Holds work with firm tension grip on any surface, even slanting or irregular; ball and socket swivel (replaceable) prevents shifting or creeping. *Release instantly*—simply loosen handle and push on trigger—clamp lifts free, ready for application to other work. Made of Alloy-Steel of Forged Clamp Capacity. SPATTER-PROOFED—All working parts are COPPER PLATED against welding spatter.

EXTRA DEEP THROATS

	Opening	Throat
No. 4-ASL	4¾"	4¼"
No. 6-ASL	6¾"	4¾"
No. 8-ASL	8¾"	6"

PROMPT SHIPMENT

Write for Catalog on Complete Line of GRAND Speed Clamps for every kind of work.

GRAND SPECIALTIES COMPANY
3106 W. Grand Avenue Chicago 22, Ill.

Aircraft Engineering
FOUNDED 1929
The Technical and Scientific Aeronautical Monthly
Edited by
Lt.-Col. W. Lockwood Marsh
F.I.Ae.S., M.S.A.E., F.R.Ae.S.

Single Copies: 50 cents post free
Subscription: $5.25 per annum, post free

During the War, a special feature is being made of reproductions and translations from the Foreign Technical Press

BUNHILL PUBLICATIONS LIMITED
12 Bloomsbury Square
London : : W.C.1.
England

first aid, and saving life. The five sections of the book deal separately with survival in general, survival in the jungle, survival in the Arctic, survival in the desert, and survival at sea. A bibliography is included.

San Francisco Chamber of Commerce Bibliography; Chamber of Commerce, Aviation Department, San Francisco, 1945; 42 pages.

A bibliography of material on aviation available for general circulation through the Aviation Department Library as of February 1, 1945. The material is filed under 42 subject headings, which are listed.

The First Annual Yearbook of the Glendale Rocket Society, 1943–1944, edited by George James; Glendale Rocket Society, Glendale, Calif., 1944; 51 pages.

The progress and activities of the Glendale Rocket Society are reported in the second edition of their yearbook. Rocket experiments are described and rocket models developed by members of the Society are illustrated. Information is given about rocket tests, rocket weapons, rocket fuels, and jet propulsion.

Report of Committee on Aeronautical Law; New York State Bar Association, New York, 1945; 11 pages.

This pamphlet contains the report of the Committee on Aeronautical Law which was presented at the Sixty-Eighth Annual Meeting of the New York Bar Association on January 19 and 20, 1945.

Industrial Production Illustration for Students, Draftsmen, and Illustrators, by Randolph Philip Hoelscher, Clifford Harry Springer, and Richard F. Pohle; McGraw-Hill Book Company, Inc., New York, 1943; 213 pages, $3.50.

In writing this book the authors' object has been to provide a practical text on the theory of pictorial drawing. The text has been prepared especially to meet the requirements of draftsmen working in the aircraft, ordnance, and shipbuilding fields. Perspective, therefore, is dealt with from the point of view of the machine and aircraft industries, rather than from the conventional architectural approach. Particular mention may be made of the exact method of making axonometric projections presented in one chapter, and of the charts devised for the rapid production of accurate freehand sketches in the oblique, shown in the chapter on oblique projection. Graded problem material is included, to permit the instructor to give a well-rounded course without monotonous repetition.

Stress Relief of Weldments for Machining Stability, by J. R. Stitt; College of Engineering, The Ohio State University, Columbus, Ohio, 1944; 47 pages, $0.50.

A report of an investigation that was conducted to determine the effect of thermal stress relief treatments, having maximum temperatures of 900, 1,000, 1,100, 1,200, 1,300, and 1,400°F., upon the stabilities of weldments during machining operations. The specimens used throughout this investigation were made from four high-tensile steels. Curves graphically depicting the improvement obtained by various thermal treatments are shown.

Strain gage calculations from the same specimens are tabulated in various forms. Five appendixes supply information about 90° cross weldments, deflection-measuring devices, strain-gage measurements, stress relieving, and mechanical-property tests.

A.S.T.M. Standards 1944; American Society for Testing Materials, Philadelphia, 1945; Part I, 2,047 pages; Part II, 1,649 pages; Part III, 2,202 pages, $10 each.

The complete new 1944 book of A.S.T.M. Standards, issued in three parts, contains in their latest approved form all of the Society's widely used specifications and tests for materials. The latest edition has 1,235 specifications and standard methods which cover more than 6,000 pages.

All specifications, whether formal standards or tentative, are given. The book is issued in three parts, the divisions being as follows: Part I, Metals, ferrous and nonferrous metals (all A and B and some E serial designations), except methods of chemical analysis, general testing methods (E serial designations); Part II, Nonmetallic materials—Constructional—cementitious materials, concrete and aggregates, masonry building units, ceramics, pipe and tile, thermal insulating materials (all C serial designations), wood and wood preservatives, paints, varnishes and lacquers, road materials, waterproofing and roofing materials, soils (certain D serial designations), general testing methods, thermometers (E serial designations); Part III, Nonmetallic Materials—General—fuels, petroleum products, electrical insulating materials, rubber, textiles, soaps and detergents, paper, plastics, water (remainder of D serial designations), general testing methods, thermometers (E serial designations).

An innovation in this 1944 book is the inclusion of all emergency standards and emergency alternate provisions which have been widely used to expedite production and procurement of important materials. Each part of the book has a complete subject index, containing from 36 to 44 pages. There are two extensive tables of contents; the first lists all standards under general material headings; the second, according to the serial designations of the standards.

Demonstrations and Laboratory Experiences in the Science of Aeronautics, prepared with the cooperation of the Civil Aeronautics Administration and the American Council on Education; McGraw-Hill Book Company, Inc., New York, 1945; 155 pages, $2.00.

Experiments, demonstrations, and devices designed to help the student understand basic problems of aeronautics are presented in this manual. Only simple, easily available materials or supplies are needed for the construction of most of the devices described. No complicated techniques or skills are involved in their construction. Only common home or laboratory tools are required for the work, which can be carried out in a reasonably short time. A few more elaborate designs are included for schools having the facilities for making them.

The manual is divided into sections corresponding to the different general subjects involved in the study of aeronautical engineering. After the first section, which gives general instructions for the use of the manual, the main sections refer to aerodynamics, power plants, meteorology, navigation, and communications. The final section includes supplementary demonstrations of various special instruments.

Jet Propulsion, by Thomas N. Dalton; Thomas N. Dalton, Elizabeth, N.J., 1944; 45 pages, $1.00.

J-P Fundamentals, by Thomas N. Dalton; Thomas N. Dalton, Elizabeth, N.J., 1944; 11 pages, $0.50.

The first essay on jet propulsion has to do with those factors that tend to be adverse to the use of reaction propulsion for aircraft. The study is divided into nine sections, of which the first five give definitions and discuss the fundamental laws upon which jet-propulsion devices are based. The others deal with the efficiency of jet power plants developed up to the time of writing the essay and the limitations that led the writer to an unfavorable conclusion about the prospects of jet propulsion.

The second of these two essays is devoted to a mathematical analysis of the propulsive forces, effective power, and power efficiency of rocket-type propulsion units and turbine-compressor jet-propulsion units.

The Chemistry of Acetylene, by Julius A. Nieuwland and Richard R. Vogt; Reinhold Publishing Corporation, New York, 1945; 219 pages, $4.00.

The preparation, properties, and reactions of acetylene are dealt with in this volume. The arrangement of the text is based on a classification of the methods of preparation and types of reactions of acetylene rather than on considerations of historical sequence or industrial status. An extensive classified bibliography is included.

Cast Metals Handbook; American Foundrymen's Association, Chicago, 1944; 750 pages, $6.00.

In the review of the above book appearing on page 139 of the February, 1945, issue of the AERONAUTICAL ENGINEERING REVIEW the price was erroneously given as $3.75. The correct price of the volume is $6.00.

Operatorenrechnung nebst Anwendung in Physik und Technik (Operational Calculus and Its Application in Physics and Technique), by KarlWilly Wagner; Johann Ambrosius Barth Verlag, Leipzig, 1940; published and distributed in the public interest by

ANOTHER MARTIN FIRST
Two-Fisted Terror! Guns controlled by Martin plastic hand grips have shot down more enemy aircraft than any other turret guns in this war. These grips give quick, easy, comfortable turret control, thus helping increase accuracy of fire.

Axis Airmen Can't Wriggle out of these Deadly Grips!

Handfuls of Power! With one of these Martin *plastic* grips in each hand, Allied aerial gunners can swing turrets in vertical and horizontal planes, control gunfire, even regulate intercommunication system.

Martin plastic hand grips give gunners greater accuracy

Stepping up accuracy of fire, reducing fatigue strain on aircraft gunners, Martin plastic hand grips are an important factor in maintaining and increasing Allied aerial superiority. Used on Marauders, Marylands, Baltimores, Coronados, Liberators, Havocs, Venturas, Invaders, Black Widows, the training turrets of Beach aircraft and on such British planes as Lancasters, Bostons and Sunderlands, these grips have helped account for more enemy aircraft than any other type of control.

Unlike metal grips, which freeze to the gunner's hand at high altitudes, the Martin plastic hand grips give maximum efficiency at all altitudes. Gunners have only to swing the grips right or left, up or down and the turret responds instantly, keeping the target in the sights. Extended and indented to fit the hand, they insure greater comfort and ease of operation—while providing firm braces for the gunner to grip when the plane bucks or pitches. When used in the famous Martin aerial turret, they give our gunners one of the war's most deadly weapons.

These plastic hand grips are typical of the many developments which have been perfected by Martin to improve both performance and production of Allied warplanes. Today pledged to war, Martin skill and ingenuity will, in the days to come, make major contribution toward building a more abundant world.

THE GLENN L. MARTIN CO.,
BALTIMORE 3, MD.

The Glenn L. Martin-Nebraska Company—Omaha

Martin
AIRCRAFT

Builders of Dependable Aircraft Since 1909

BETTER STOCK UP NOW? Yes, the one thing that's patriotic to hoard is War Bonds! Remember, War Bonds aren't sold in peacetime, so better stock up on these safe, high-profit investments *now!* You'll be glad you did, when you get 4 dollars for every 3 you invest!

authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 448 pages, $9.50.

This book is intended to be an introduction to engineers and physicists of a new method of operational calculus and the manner in which it may be applied. The author claims that the operational calculus as devised by Heaviside is not satisfactory and leads to wrong results and that his own method gives correct results in a much easier and quicker way than other methods. He lists problems that he states have been solved for the first time by means of his system.

Passung und Gestaltung, ISA Passungen (Fits and Forming, International Standards Association Fits), by Paul Leinweber; Verlag von Julius Springer, Berlin, 1941; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 240 pages, $5.00.

It is stated that this book is intended for those whose work takes in fits and tolerances and that the method of fits is just as important a principle of modern manufacture of interchangeable parts as are material testing, strength theory, and manufacturing technique. In order to show what modern science and techniques have accomplished in regard to interchangeable parts, the author presents a historical review showing how modern manufacturing methods developed gradually from the handmade pieces of old-time craftsmen.

The contents are: (1) Division of Operations—Manufacture of Interchangeable Parts—Standardization; (2) Why International Cooperation?; (3) The Individual Point of Fit, and Application of the ISA Fields of Tolerances; (4) Effect of Fits on the Surroundings of the Point of Fit, on Forming, and on Calculation; (5) Geometry of Fits; (6) Mechanics of Fits; (7) Introduction of the ISA Fits.

Werkstoffe fuer Gleitlager (Bearing Materials), edited by R. Kuehnel; Verlag von Julius Springer, Berlin, 1939; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 427 pages, $8.65.

Since sometimes only a few of the materials used for bearings are domestic products, it is necessary for certain countries that lack essential raw materials to search for proper substitutes.

According to the author, this book is the outcome of such researches. It contains the following: (1) a general section, subdivided into principles of construction, selection and evaluation, and bearing testing; (2) a main section, subdivided into plastics and metallic bearing materials, such as alloys, hardened, and silicon-treated materials. Alloys are grouped according to the predominant element.

Reine Metalle (Pure Metals), edited by A. E. van Arkel; Verlag von Julius Springer, Berlin, 1939; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 574 pages, $12.50.

The purpose of the editor of this monograph about pure metals was to collect everything that might facilitate a survey of available information about the development of modern methods to rid metals of their impurities, to discover where there are still some gaps, and, if possible to find new ways to fill these gaps.

Each collaborating author gives his individual point of view. In those cases where the contribution was written in a foreign language no translation has been attempted. It should be borne in mind that only pure metals are discussed and that alloys are considered only if their characteristics differ from those of conventional alloys because of a combination of pure components.

Bauelemente der Feinmechanik (Structural Elements of Fine Mechanics), by O. Richter and R. Voss; VDI—Verlag G.M.B.H., Berlin, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 491 pages, $10.

According to the authors, this book is a collection of tested examples rather than a textbook. The various structural elements of fine mechanics are presented systematically and treated comprehensively. This is intended to lead to a better understanding of important points of view in the designing of precision instruments and may also give valuable suggestions to the experienced engineer. The principal chapters are grouped into sections as follows: (1) Connections; (2) Guides; (3) Stops; (4) Media of Motion; and (5) Speed Controls.

Handbuch der Meteorologischen Instrumente und Ihrer Auswerhung (Handbook of Meteorological Instruments and Their Evaluation), edited by E. Kleinschmidt; Verlag von Julius Springer, Berlin, 1935; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 733 pages, $20.

This handbook is intended to give a survey of instruments in actual use for meteorologic observations. Numerous specialists in the various branches of meteorology acted as collaborators. According to the editor, the aim of this book is to enable the reader to select the instruments that he thinks the most practical for his own purpose, and to become acquainted with their operation, their sources of error, and the accuracy of measurement which may be obtained with them. The editor hopes that this may stimulate new designs or improvements of instruments now in use.

Technische Stroemungslehre (Technical Aerodynamics), by Bruno Eck; Verlag von Julius Springer, Berlin, 1941; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 252 pages, $5.00.

The principal laws of aerodynamics are presented, with first consideration given to theoretic and experimental research results of most practical value. Mathematical expedients have been limited to bare essentials. The application of the laws is shown by means of many experimental and numerical examples, and object lessons are used to make difficult problems more comprehensible. As the reader might expect, there is given first a quantitative and qualitative description of the effects of friction. These problems are discussed in detail.

Werkstoff-Handbuch Stahl und Eisen (Material Handbook Steel and Iron), edited by Karl Daeves; Verlag Stahleisen m.b.H., Duesseldorf, 1937; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; various paging, $13.50.

This book has been developed from the original loose-leaf book of data sheets on iron and steel published by the German Iron Mining Association. According to the editor, most of the data contained in this book have been checked by manufacturers as well as by consumers. In this way they not only represent the views of the individual authors but also those of a majority of practical specialists. The book is divided into various groups of data sheets which were published up to the end of 1937.

A bibliography is added to almost every sheet. The groups are as follows: General Information; Properties and How to Test Them; Types of Iron and Steel of Special Composition and Manufacture; Steel Types for Certain Fields of Application; Steel Treatment and Testing.

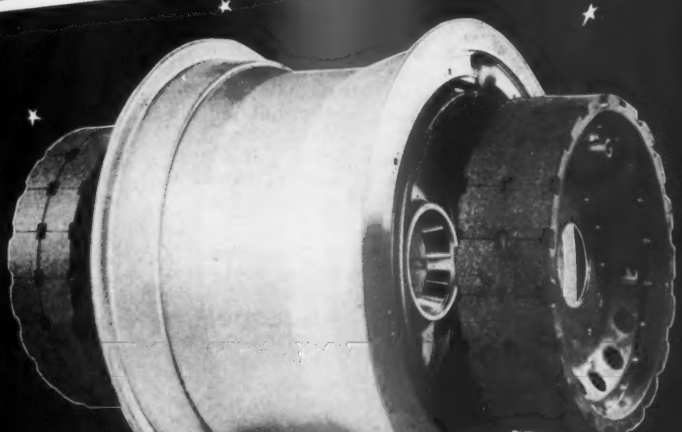
Grundlagen fuer die Messung von Stirnraedern mit Gerader Evolventenverzahnung (Principles of the Measurement of Spur Wheels Which Have Straight Involute Gearing), by G. Berndt; Verlag von Julius Springer, Berlin, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 155 pages, $5.85.

It is stated that, of all machine parts in common use the cog wheel is the only one that has no standardized tolerances. However such standards may be established only if the permissible deviation from the nominal values is determined by measurement. Measurements on cog wheels are made difficult by the fact that most of the magnitudes to be determined are not concrete but, as a rule, are imagined to be sections that have a very complicated form. Therefore, a geometry for these meas-

ARMY E NAVY

HAYES INDUSTRIES

BOEING
CESSNA
CHANCE VOUGHT
CONSOLIDATED VULTEE
COLUMBIA
CURTISS WRIGHT
DOUGLAS
EDO
ERCOUPE



FAIRCHILD
GRUMMAN
LOCKHEED
MARTIN
NORTH AMERICAN
PIPER
STINSON
WACO

CONTINENTAL
EASTERN
PCA
UNITED
WESTERN
Air Lines

over 1,200,000 WHEELS AND BRAKES

While war wings its way farther toward victory—Hayes Industries offers our military, naval and civilian forces a record of *not one day's production lost* since defense work started and war's grim demands followed.

In this time—well over 1,200,000 Hayes Industries aircraft wheels and brakes have moved onto the world's runways—keeping pace with training, transport and combat needs... meeting ever-higher loadings and landing speeds... doing the job the builders want and the pilots and ground crews expect... and get!

All U.S. 4-Engine Bombers, including BOEING B-17 and B-29 and CONSOLIDATED B-24, and transports such as CURTISS C-46, are equipped with Hayes Wheels and EXPANDER TUBE BRAKES.

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles 36, Calif.

HAYES INDUSTRIES, INC. ★ Home Office: JACKSON, MICHIGAN, U.S.A.

urements has to be developed. Until now a thorough investigation of the principles was lacking.

These facts receive special attention in this book. As to acceptance of conditions, simple methods had to be developed. Principles generally applied to the acceptance of standardized parts are not applicable to gears, as they are not matched with a counterpart but with a part of similar type. Furthermore, fitting does not take place when the gear is at rest, but only during rotation, which poses a dynamic problem. So-called master gears and master racks are in many cases not sufficiently accurate, so that proper gages had to be devised. It is furthermore stated that in the investigations presented in this book the obtainable accuracy of measurement is given numerically.

Technische Thermodynamik (Technical Thermodynamics), by F. Bošnjaković; Verlag von Theodor Steinkopff, Dresden, Volume I, 1935, Volume II, 1937; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1945; Volume I, 221 pages; Volume II, 314 pages, $15 per set.

This book discusses the essentials of thermodynamic problems without the extensive use of mathematical expedients. The author has selected the various problems in such a way that they may serve as a framework for the development of general thermodynamic principles.

The book is published in two volumes, accompanied by an envelope containing seven diagrams. The first part of this book gives an introduction into classic thermodynamics and deals with some especially important heat problems of primary materials, with special consideration of the second fundamental law.

According to the author, the contents of the second part of the book may seem to be somewhat out of the ordinary because he treats thermodynamic problems of binary mixtures which at first sight do not seem to have anything in common.

The three coordinates of the diagrams shown embody the three natural laws that govern every phenomenon. The coordinate of the composition represents the law of preservation of the mass; the law of preservation of energy (the first fundamental law) is represented by the coordinate of heat content; while the coordinate of entropy represents the second fundamental law. It is stated to be obvious that phase diagrams whose coordinates embody these three natural laws are very appropriate to an investigation of the various heat problems.

The author finally calls attention to the tremendous loss of heat energy in the chemical and metallurgical industries because of the irreversibility of the various processes. In his book he shows ways and means to determine these irreversibilities numerically.

Technische Statik (Technical Statics), by Wilhelm Schlink; Verlag von Julius Springer, Berlin, 1930; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 386 pages, $10.50.

A compilation of the author's lectures as professor at the Darmstadt Technical Academy. It deals only with rigid bodies but discusses in detail internal effects and magnitude of stresses in structures. It is stated that these conceptions and their evaluation sometimes cause considerable difficulties, especially when the design departs from conventional lines. This becomes very evident in three-dimensional structures which are subject to the effect of six internal forces, namely, two transverse forces, one longitudinal force, two bending moments, and one torsional moment. The book gives special attention to three-dimensional problems because the author finds a prevalent tendency to consider three-dimensional designs as being two-dimensional or as being composed of such elements.

The main chapters are: Forces Acting on a Common Point; Forces Distributed in the Plane; Application to Two-Dimensional Supported Bodies (Discs); The Two-Dimensional Framework; Forces Distributed in Space; Bodies Supported by Means of Bars or Bearings; The Three-Dimensional Framework and Composite Construction.

Statik und Dynamik der Schalen (Statics and Dynamics of Shells), by Wilhelm Fluegge; Verlag von Julius Springer, Berlin, 1934; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 240 pages, $5.75.

It is stated that the modern development of shell construction posed problems the solution of which are of interest to the design engineer as well as to the investigating scientist. According to the author, this book meets the requirements of both. As far as possible it presents each calculation in the most complete detail and, where necessary, difficult mathematical problems are worked out to reach the desired purpose.

After an introductory chapter stating the general principles, the chapters discuss the membrane theory of rotational cylindric shells and of translation planes; stress condition of affined shells; bending theory of circular cylinder shells and of rotational shells; the "Faltwerk" theory, defined by the author as a shell whose center surface is a prism; stability of shells; and vibrations of symmetric rotational shells.

Library Accessions

Mechanical Vibrations, by J. P. Den Hartog; McGraw-Hill Book Company, Inc., New York, 1940; 448 pages, $5.00.

Second edition of a textbook on mechanical vibrations. In this edition a number of errors have been rectified and discussions have been included on the more important advances made in the subject during the years 1934 to 1940. The new material is concerned primarily with electrical measuring instruments, centrifugal pendulum dampers, aircraft and ship propellers, and automatic balancing machines. The number of problems has been increased and a second appendix added which lists the formulas likely to occur in practice.

Return at Dawn, by Hilary A. St. George Saunders; The Director of Publicity, Wellington, New Zealand, 1942; 52 pages.

An official record of the R.A.F.'s New Zealand Bomber Squadron from June, 1939, to July, 1942.

Guia Aeronautica de Aeropistas 1939, by Luis Gonzalez Moreno; Intava S.A., Buenos Aires, 1942; 344 pages, $2.25.

This handbook is concerned with the airports, flying fields, and emergency landing fields in Argentina. It includes traffic, meteorologic, geographic, and radio data pertaining to those airfields.

Achievement in British Aircraft, by S. E. Veale; The Pilot Press Ltd., London, 1942; 36 pages, 2*s.* 6*d.*

The progress of British aircraft construction and production during 4 years of war is recorded in this illustrated pamphlet.

Pinpoint the Bomber, by Francis Chichester; George Allen & Unwin, Ltd., London, 1942; 46 pages, 10*s.*

Directions are given for playing three games based on a knowledge of map reading. In addition to the game instructions, the book provides data on and exercise in map reading of benefit to the beginner in air navigation.

Biggles Defies the Swastika, by Capt. W. E. Johns; Oxford University Press, London, 1941; 249 pages, 4*s.*

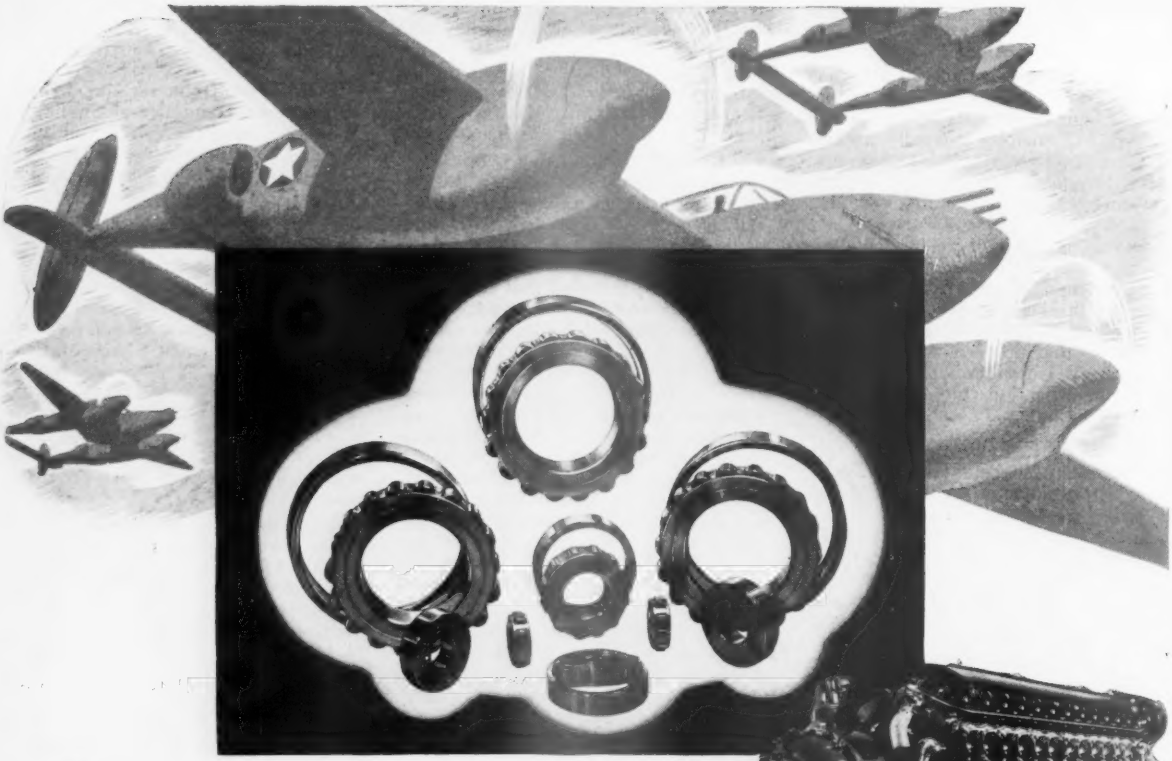
One of a series of adventure stories for boys. In this the hero becomes a member of the German Air Force for purposes of British intelligence.

Eagles in Exile, by Pat Beauchamp Washington; Maxwell, Love & Company, Ltd., London, 1941; 128 pages, 7*s.* 6*d.*

An account of the Polish Army's activities in Poland and elsewhere during World War II.

The Air Killer, by James Corbett; Herbert Jenkins Ltd., London, 1941; 254 pages, 7*s.* 6*d.*

A mystery novel, in which a murderer attacks his victims from the air.



Powered by Allison . . .

BEARINGS: HYATT

It is with considerable pride that we are able to include several of the Allison-powered fighting planes among the famous aircraft with Hyatt equipment.

In the Allison engines Hyatt Precision Roller Bearings are used on the propeller reduction gear drive and starter and generator drive shafts which also function in driving other accessory units.

Dependable Hyatt Roller Bearings also serve in other aircraft engines as well as in starters, superchargers and propellers.

HYATT BEARINGS DIVISION · GENERAL MOTORS CORPORATION

Harrison, New Jersey · Chicago · Detroit · Pittsburgh · Oakland, California

Aeronautical Engineering, edited by R. A. Beaumont; Odhams Press Ltd., London, 1942; 512 pages, 6*s*. 6*d*.

A textbook on the construction, operation, and repair of air frames and aircraft engines. This book is intended as a guide to the related functioning of all the component parts of an airplane.

An Introduction to Aeronautical Engineering, Volume 3, Properties and Strength of Materials (Metals), by J. D. Haddon; Sir Isaac Pitman & Sons, Ltd., London, 1942; 192 pages, 8*s*. 6*d*.

Supplementing two preceding volumes, one concerned with the principles of flight and the other with internal structural problems of airplane design, this book completes the series with a study of the principal metals used in the structure of aircraft and of the methods for determining the sizes of air-frame structural members from the loads in them. In its fourth edition, Volume III contains several alterations and additions to its original version. The more important of these are pertinent to nitriding, normal stress, torsion test, principal stresses, Wagner beam, and elastic instability of struts.

This Expanding War, by Liddell Hart; Faber and Faber Ltd., London, 1942; 278 pages, 12*s*. 6*d*.

This review of the war's course during 1941 combines a view of events as they took place at the time with a view of them in retrospect. A complete series of the author's newspaper articles for the year is reproduced, together with a commentary that makes use of facts that have become known subsequently. There are also a number of memoranda and a few articles embodying the author's ideas on specific problems pertinent to the waging of the war.

Wimpy the Wellington, by E. F. Herbert; Frederick Muller, Ltd., London, 1942; 30 pages, 2*s*. 6*d*.

A story about a Wellington bomber written for very young children.

Airframes, a Manual for Mechanics and Students, 2nd Edition, by J. Campbell Corlett; Sir Isaac Pitman & Sons, Ltd., London, 1942; 126 pages, 5*s*.

Second edition of a primer outlining the principles of aircraft construction and maintenance. Differences from the first edition consist of alterations in the text, revisions of illustrations, deletion of the word "rigging" from the title, and the addition of new material.

Aircraft Calculations; A New Edition of Aircraft Mathematics, by S. A. Walling and J. C. Hill; Cambridge University Press, Cambridge, England, 1942; 159 pages, 3*s*.

This book has been revised to conform with modifications made in the syllabus of mathematics for Air Training Corps cadets. Besides the change of title, new exercises have been added and problems based exclusively upon navigation have been omitted. The primary difference from the original editions is the rearrangement of material. The text is now divided into two parts: One contains the revisionary work and exercises that are definitely within the scope of the syllabus. The other part is made up of exercises and problems involving the simple fundamental rules of algebra, geometry, logarithms, and trigonometry.

Airmen's Mathematics, by M. J. G. Hearley and R. Leverington Smith; Sir Isaac Pitman & Sons, Ltd., London, 1942; 115 pages, 3*s*. 6*d*.

Designed for use in training units of the Royal Air Force and the Air Training Corps, this is a manual of the elementary mathematics required by pilots, observers, and those engaged in ground-staff duties for the air forces. Exercises are appended to each chapter to test the student in his knowledge of the arithmetic, algebra, geometry, and trigonometry involved.

Position Tables for Air and Sea Navigation, by F. G. Brown; Angus & Robertson Ltd., Sydney, 1941; 1 Volume, 15*s*.

These tables are intended for use in drawing a position line in air or sea navigation. Applicable for all latitudes up to 75°, they obviate the need for trigonometric or logarithmic calculations.

Fire Prevention Hints, prepared under direction of London Fire Brigade, London County Council; P. S. King and Son, Ltd., London, 1940; 46 pages, 3*d*.

Based on actual fire-brigade experience, suggestions are given on how to avoid and combat fires, escape from fires, and treat persons who have been injured by fire. Special sources of danger are considered—such as gas installations; electricity; the likelihood of children, animals, or aged people starting fires; and fire agents that are peculiar to war. An appendix contains an analysis of the causes of fires in which lives were lost in London during 1938.

Astrographics, First Steps in Navigation by the Stars, by Frank Debenham; W. Heffer & Sons Ltd., Cambridge, England, 1942; 2nd edition, 120 pages, 7*s*. 6*d*.

In this second edition of a navigation primer several figures have been replaced. Additions have been made to certain passages that were either too brief or too obscure.

Air Navigation for Cadets, by D. E. Webster; J. M. Dent and Sons, Ltd., London, 1942; 87 pages, 2*s*. 6*d*.

An introductory text instructing students in the use and construction of four navigational instruments: the map, the compass, the air-speed indicator, and the altimeter. Exercises drilling the reader in the knowledge offered are included in each chapter.

The Navigator's Star Altitude and Azimuth Tables, by J. Bain; Brown, Son, & Ferguson, Ltd., Glasgow, 1928; 64 pages.

By means of these tables, a short and simple method is offered for finding the ship's position by simultaneous observations of the stars on the Marcq St. Hilaire principle. The method requires working the exact D.R. latitude and longitude, obviating the need for algebraic signs.

Materials and Structures, by D. A. R. Clark; Blackie & Son Ltd., London, 1941; 384 pages, 25*s*.

Written to meet the needs of students preparing for an examination in strength of materials and structures, this book also includes some insight into the production and properties of materials. A considerable number of examples are worked out in the text, and exercises are set at the end of each chapter on the subject of that chapter.

Rubber and Its Use, by Harry L. Fisher; Chemical Publishing Company, Inc., Brooklyn, N.Y., 1941; 128 pages, $2.25.

A study of the nature of rubber, its history, its sources, how it is obtained, and how it is manufactured into various types of articles. In addition to the properties and applications of natural rubber, new developments in synthetic rubber are discussed.

High Speed Diesel or Compression Ignition Oil Engines, by A. H. Goldingham; E. & F. N. Spon, Ltd., London, 1942; 171 pages, 15*s*.

The application of the modern high-speed Diesel or compression-ignition engine for various land- and marine-propulsion purposes is described. Recording events of historical value in the development of the Diesel-engine industry before and up to the year 1932, the book also presents particulars relative to fuel-injection equipment. In addition, methods of treating and preventing troubles caused by torsional vibration are investigated.

Engineering and Aircraft Limits, Fits and Tolerances, by H. Parkinson; Sir Isaac Pitman & Sons, Ltd., London, 1942; 29 pages, 2*s*.

A detailed introduction to the subject, together with a practical and design section on aircraft manufacturing tolerances.

Gladiators Over Norway, by Victor MacClure; W. H. Allen & Company, Ltd., London, 1942; 46 pages, 1*s*. 6*d*.

The story of a Royal Air Force fighter squadron that was sent from Britain to help oppose the Nazi invasion of Norway. As the events are recorded, there were two definite phases of this air fight: one around the Aandalsnes area; the other around Narvik.

The Air Cadet's Handbook on Engine Mechanics, Part I, by W. D. Arnot; George Allen & Unwin Ltd., London, 1942; 76 pages, 2*s*.

This booklet explains in brief form what is meant by horsepower, discusses the materials of which engines are made, and tells of the heat-treatment processes that are used to fabricate the materials. It also describes engine components and how they are assembled.

IF IT'S A

SPECIAL JOB

FOR A SPECIAL BOLT

THOMPSON

can engineer and make it!

These special close-tolerance, high-strength Thompson Bolts were designed and manufactured for certain vital jobs on aircraft—jobs that, investigation proved, no "stock" bolt could ever do. One is a main wing-attaching shear bolt, for example. Another is used under extreme tension conditions. Another is an oversize bolt for a special re-working job . . . another is a wing stud for the Douglas C-54 . . . and still another is for use with bomb straps for holding bombs in the bay. And they range from external hex head types to flush head internal hex types—and in all sizes—for every kind of installation need.

BUT WHATEVER THE SPECIAL JOB MAY BE, all these Bolts have one thing in common: They are made under an exclusive Thompson hot-gathering and forging method which raises shear strength, tensile strength and structural uniformity to the extremely high ranges required for maximum safety and dependability. In addition, all surfaces are finish ground where required, as are threads, resulting in a precision-made aircraft bolt that's capable of efficiently handling the toughest of the connecting jobs on aircraft.

If you are encountering bolt failure, or need special bolts for special applications, our engineers will be glad to send details on Thompson Bolt specifications and work with you in designing and making special bolts for your particular need. Write Thompson Products, Inc., WEST COAST PLANT, Bell, California.

The story of Thompson Precision in bolt making is contained in a 16-page illustrated Brochure, sent without obligation on request. Write for your copy.

ARMY E NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

Factory Defence, by Col. G. A. Wade; Gale & Polden Ltd., Aldershot, England, 1942; 24 pages, 1*s.* 6*d.*

This pamphlet is one of a series and deals specifically with the defense of British factories against sabotage or German invasion. It advises about what to safeguard against and how to go about doing it.

The Hypergeometric and Legendre Functions with Applications to Integral Equations of Potential Theory, by Chester Snow; National Bureau of Standards, Washington, D.C., 1942; 319 pages, $2.00.

An outline of the theory of, and a collection of formulas pertaining to, the ordinary hypergeometric function with especial reference to the associated Legendre functions. The linear and quadratic transformation and analytic continuations of the hypergeometric function of z to all parts of the z-plane are written out at length and for unrestricted values of its three parameters.

How to Identify Warplanes, Friend or Enemy; Richfield Oil Corporation of New York, New York, 1942; 33 pages.

The salient features of each plane are pointed out in the descriptive data that accompany silhouette drawings showing the military and naval aircraft of various countries. Those nations whose planes are included in this compendium are United States, Great Britain, Russia, Germany, Japan, and Italy.

Airmails, by Emil Bruechig; Emil Bruechig, New York, 1940; 34 pages.

This brochure for philatelists briefly outlines the history of air-mail-stamp collecting. Various collector's items are illustrated.

Fundamentals of Vibration Study, by R. G. Manley; Chapman and Hall, Ltd., London, 1942; 128 pages, 13*s.* 6*d.*

An introductory book on the principles of vibration. Attention is confined to basic theory; instrumentation and testing techniques are not included within the scope of the book. No previous knowledge of differential equations is assumed.

The Defence of Calais, by Eric Linklater; His Majesty's Stationery Office, London, 1941; British Information Services, New York; 36 pages, $0.10.

A record of the defense of Calais by the British Expeditionary Forces in 1940. Events are traced from May 22 through May 25.

Aeronautics Laws of the State of Indiana, The Secretary of State, Indianapolis, Indiana, 1939; 17 pages.

This compilation of the State aviation laws in Indiana is divided into four parts: the first presents the laws relative to airports; the second, the uniform aeronautics law; the third, regulations dealing with the licensing of aircraft and airmen; and the fourth, miscellaneous aviation laws.

Biggles in the Baltic, by Capt. W. E. Johns; Oxford University Press, London, 1941; 256 pages, 4*s.*

In this adventure story for boys the hero is detailed to form a Royal Air Force unit for special detached duty in the Baltic. The operations of this air unit from a secret base afford the material for exciting events.

Model Plane Book, by M. B. Kleckner; M. B. Kleckner, Akron, Ohio, 1940; 1 volume.

By means of diagrams instructions are given for the making of various model planes and their components.

War Gases, Learn and Live, by W. F. F. Shearcroft; Jordan & Sons Ltd., London, 1942; 24 pages, 6*d.*

Third edition of a handbook describing the nature, types, and characteristics of war gases, as well as methods of safeguarding against, combating, and detecting them. A gas-detection table is appended.

Brief Notes on Navigation, by C. Bertram Lenthall; Sherratt and Hughes, Altrincham, 1942; 92 pages, 2*s.*

Second edition of a navigation manual compiled for the use of Air Training Corps Cadets undergoing a course of instruction. The new edition is revised and enlarged, and includes a new chapter on "Fixing Position."

The Machine Shop Yearbook and Production Engineers' Manual, Volume 2, edited by H. C. Town; Paul Elek, London, 1942; 497 pages, 25*s.*

A résumé of the fundamentals of machine construction, operation, and design is supplemented by the inclusion of data on mechanical, electrical, and hydraulic improvements as they appear in relation to the engineering industry.

Vanguard to Victory, by Skene Catling; Methuen & Company, Ltd., London, 1940; 235 pages, 6*s.*

A compilation of the author's newspaper dispatches serves as a classified and coherent account of the first few months spent by the British Expeditionary Force in France during the winter of 1939–1940.

We Rendezvous at Ten, by "Blake"; Victor Gollancz Ltd., London, 1942; 160 pages, 8*s.* 6*d.*

An action story about the R.A.F. While the characters are imaginary, the incidents are reported to be based on fact.

Understanding Aero Engines by Question and Answer, by W. Hazell; English Universities Press, London, 1942; 159 pages, 2*s.* 6*d.*

This introduction to the design and operating principles of aircraft engines is presented in the form of question-and-answer exercises. The six chapters outline the fundamentals of (1) internal-combustion engine theory; magneto and valve-timing; (2) magneto construction and theory; (3) simple carburetor; aero carburetors; (4) engine-running faults, detonation, etc.; (5) supercharging; (6) Hobson boost control: fixed datum: variable and three-stage controls.

Fighting Talk, by Francis Raymond Meyer; Francis Raymond Meyer, Lynbrook, N.Y., 1942; 32 pages, $0.10.

A dictionary of the slang used by the U.S. Army, Navy, and Marine Corps. The main headings under which the slang is categorized are aviation, motorized equipment, food, guns, and girls.

Metallurgy and the Aero-Engine, Sixteenth Autumn Lecture to the Institute of Metals, delivered September 6, 1937, by D. R. Pye; Institute of Metals, London, 1937; 34 pages.

Reprinted from the *Journal of the Institute of Metals,* this is the annual autumn lecture delivered before the Institute of Metals in 1937. It deals with the relation between metallurgic problems and improvements and the development of aircraft engines.

Airplanes, The Work They Do, How They Do It; Lincoln School of Teachers College, Columbia University; E. M. Hale and Company, Milwaukee, 1938; 24 pages.

The functions, construction, and component parts of an aircraft are described in verse. There are also poems dealing with the maintenance and refueling of the plane, meteorologic and radio services that aid its operation, the personnel who fly it, and certain transport aircraft.

Acoustic Models of Radio Antennas, by Edward C. Jordan; Bulletin No. 108, The Engineering Experiment Station, Ohio State University, Columbus, Ohio, 1941; 57 pages, $0.60.

Theoretic and practical fundamentals for use of acoustic models in investigating the characteristics of antenna arrangements are outlined. The study is divided into five sections, the first devoted to the analogy in free space, the second to the experimental setup; the third to directional antenna arrays; the fourth to mutual impedance measurements; and the fifth to directive sound equipment and its application.

Verses of a Fighter Pilot, by Flying Officer A. N. C. Weir; Faber and Faber Ltd., London, 1941; 78 pages, 5*s.*

Although these poems were written by a British fighter pilot, they are not about flying but are the reflection of one boy's reactions to life. They were almost all written before the poet reached the age of twenty. He was killed in action when he was twenty-one.

Air Transportation and Regulation, by G. Lloyd Wilson; The Traffic Service Corporation, Chicago, 1940; 70 pages, $0.50.

A review of the history of the principal air-line services, the regulatory conditions under which they operate, and the trends that indicate the probable future development of air transportation.

Services of the Aeronautical Archives of the Institute of the Aeronautical Sciences

The services of the Aeronautical Archives are available to all members of the Institute, to Corporate Members, to advertisers in the AERONAUTICAL ENGINEERING REVIEW and, under usual library limitations to the public. Four specialized services are available.

The Paul Kollsman Library

This lending library service makes available, *without charge*, the latest and more important aeronautical books.

As far as the facilities permit, any person in the United States over 18 years of age who can furnish references that certify to his or her responsibility may become a member of the library.

Members may request the loan of any aeronautical or technical book they wish to borrow. Through an exchange agreement with the Engineering Societies Library, any book on general engineering may be borrowed from its great collection of over 160,000 volumes.

A photostating service is available at usual library rates.

Applications for membership in the library and further information will be sent on request.

The Burden Reference Library

This reference library contains over 14,000 aeronautical books, magazines, pamphlets, photographs, reports, and clippings gathered from world-wide sources and is one of the most complete aeronautical libraries in the world. Material from this library is not available for loan but may be used for reference purposes at the Aeronautical Archives.

The Pacific Aeronautical Library

6715 Hollywood Boulevard
Hollywood, California

Established in cooperation with the aircraft companies the library serves. The leading aircraft companies in or near Los Angeles participate in its support and operation.

This service library for aeronautical research is available to the public for reading privileges. Source material includes aerodynamic and structural research reports, as well as books on drafting, production methods, history, and allied sciences. It furnishes books, periodicals, and pamphlet material to the participating aircraft companies to supplement their engineering libraries.

The Aeronautical Archives Technical Information Service

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports, and general surveys of any aeronautical subject. Some of the available services are:

Bibliographies on any aeronautical subject.
Reports on any aeronautical subject.
Digests of aeronautical books, papers, periodicals, and references.
Translations.
Engineering investigations of special aeronautical subjects.
Biographies of individuals engaged in aeronautics.
Photostats of any aeronautical or general engineering material.
Microfilms made on special order.
Photographs made from the Institute's photographic collection.
Drawings and tracings made.

In addition to the services mentioned any commission which comes within the scope of the Service will be accepted. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers.

Reproductions of any material in the Aeronautical Archives of the Institute may be ordered at standard photostat rates.

INSTITUTE OF THE AERONAUTICAL SCIENCES
1505 RCA BUILDING WEST
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

It can help you *to select the right free-cutting copper alloy*

There's a world of useful information in this 56-page book for anyone working with free-cutting copper alloys. Machinability ratings, for example ...fabricating and mechanical properties. It gives the names and compositions of these alloys, typical uses, the forms and approximate sizes available. Also contains information on the cutting speeds, feeds, tools and lubricants for best results.

You'll find this new manual by Chase invaluable in selecting the brass, bronze or copper free-cutting alloy with the right combination of properties for your product or equipment.

Send to Dept. AER-6 for your complimentary copy of *"CHASE FREE-CUTTING BRASS, BRONZE, COPPER"*

CHASE BRASS & COPPER CO.

—Incorporated—
Waterbury 91, Connecticut
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO
CINCINNATI CLEVELAND DETROIT HOUSTON
INDIANAPOLIS† KANSAS CITY, MO.† LOS ANGELES MILWAUKEE

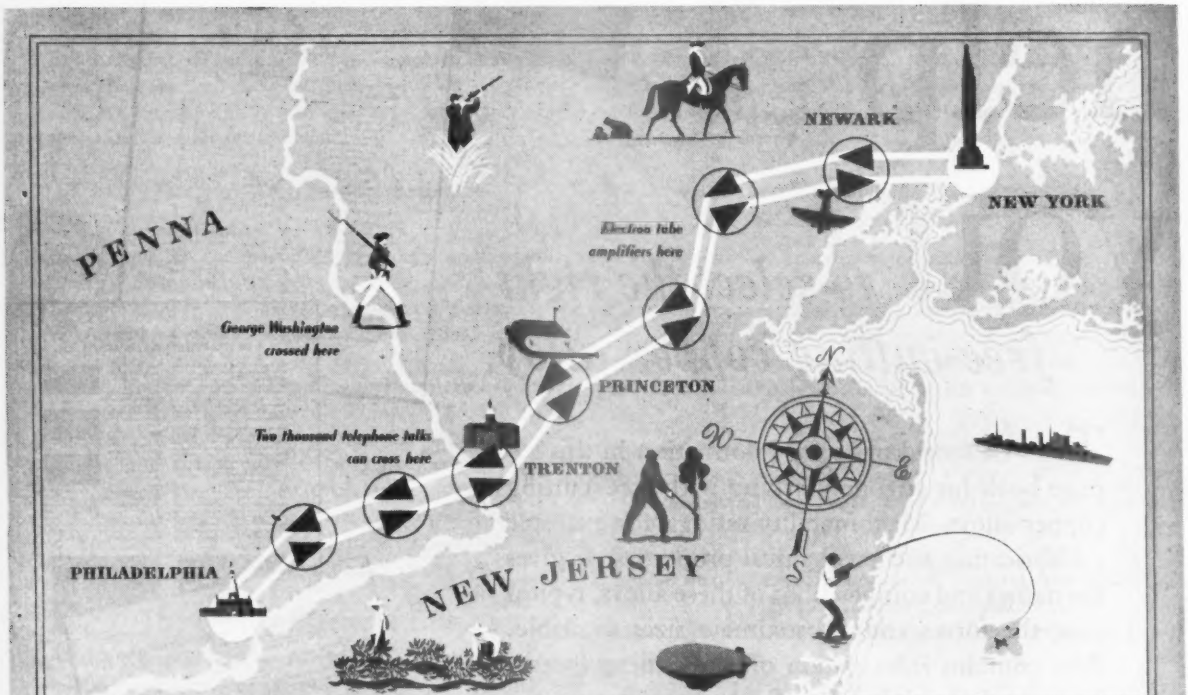
MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK
PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER†
SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON†

† *Indicates Sales Office Only*

This is the Chase Network—handiest way to buy brass

90-MILE LABORATORY

for Telephone and Television



BETWEEN telephone offices in New York and Philadelphia once stretched a strange sort of laboratory. Most of the way it was underground; engineers made their measurements sometimes in manholes. It was a lead-sheathed cable containing two "coaxials"—each of them a wire supported in the center of a flexible copper tube the size of a lead pencil.

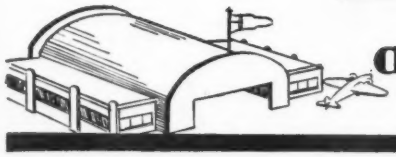
Theory had convinced engineers of Bell Laboratories that a coaxial could carry many more telephone talks than a full-sized voice frequency telephone cable; that it could carry adequately a television program. Experimental lengths were tested; terminal apparatus was designed and tried out. Finally, a full-sized trial was made with a system designed for 480 conversations. It was successful; in one demonstration people talked over a 3800-mile circuit looped back and forth. Now the cable is carrying some of the wartime flood of telephone calls between these two big cities.

This cable made television history also: through it in 1940 were brought spot news pictures of a political convention in Philadelphia to be broadcast from New York. Bell System contributions to television, which began with transmission from Washington to New York in 1927, have been laid aside for war work. When peace returns, a notable expansion of coaxial circuits is planned for both telephone and television in our Bell System work.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

House Organs and Catalogues



Plexiglas Repairs

Now You See It . . . No You Don't. An improved method of repairing imperfections in Plexiglas components is reported. In addition to imparting almost 100 per cent transparency to the repaired segment, the process is credited with meeting all airworthiness standards, reducing the number of Plexiglas parts required, and speeding up the "healing" sequence by 1 hour. It consists of mounting in place, with glue chloride, Plexiglas patches cut to exact dimensions and electrically heated. The patch is held in place with tape until the glue sets. *The Martin Star*, April, 1945.

Engine-Fuel Research

The Effect of Molecular Structure of Fuels on the Power and Efficiency of Internal Combustion Engines. Charles F. Kettering. This is a reprint in booklet form of a paper discussing the effect of the molecular structure of hydrocarbons on internal combustion engine performance. The paper was read at the annual meeting of the American Chemical Society in September, 1944. It was written to make understandable to all a subject that is usually discussed only in technical circles. It outlines an advance in petroleum refining accomplished by the research laboratories of an automobile manufacturer. The subject of triptane, its history, production, and use is discussed. Twelve charts are included. *General Motors Corporation.*

Magneto Ignition Bulletin

Magneto Ignition. The fundamentals of magneto ignition are given in an illustrated bulletin of 64 pages. The contents include such subjects as the definition of the magneto, its general purposes, magnetism and electricity, ignition requirements, early ignition systems, magneto design and construction, application of magneto ignition, impulse couplings and their use, and magneto service practices. *Bulletin FM123, Fairbanks, Morse and Company, Magneto Division*, Beloit, Wis.

Size List of Lubricant-Retaining Bearings

Compo and Powdiron Bearings Size List No. 20. Engineering flexibility in the selection of bearing sizes in standard shapes and in various powdered-metal materials, is provided in a new size list of oil-retaining bearings made of porous bronze or sintered iron.

Through possible variations in the lengths of the numerous sizes listed, as well as through the selection of material best adapted to every application from a variety of powdered-metal compositions, in both bronze and iron structures, with or without impregnated lubricant, parts can be specified from this size list.

In addition to tabulations of graduated dimensions, segregated for quick reference on sleeve-type and flanged bearings, other data on self-aligning bearings, thrust washers, bar stock, and special shapes are included. *Bound Brook Oil-Less Bearing Company*, Bound Brook, N.J.

Electronic Control Equipment

Bulletin No. Z6300 is a new 12-page catalog on *Wheelco Electronic Controls.* It is designed to supply a convenient, condensed listing of the principal items of equipment supplied by the company. Besides describing electronic principles by which control is effected without contact between measuring and control units of an instrument, the bulletin gives brief descriptions and prices of indicating pyrometers and pyrometer controllers, indicating resistance thermometers and resistance-thermometer controllers, input controllers, program controllers, portable potentiometers, combustion safeguards, and thermocouples. *Wheelco Instruments Company*, Chicago.

New Method of Plane Control

Convair Testing Revolutionary Method of Plane Control; Would Make Flying Small Craft as Simple as Car Driving. Some notes about a new method of airplane control being tested by the Stout Research Division of Consolidated Vultee Aircraft Corporation. Known as the Spratt "controllable wing," the innovation is expected to bring greater safety and easier handling to personal aircraft. It utilizes the principle that a wing may be moved relative to the airplane around two pivots in such a manner as to give control without separate control surfaces being used. The application of this principle would thus eliminate the need for ailerons, elevators, and rudders. *Convair News*, March 30, 1945; "Convair Tests Controllable Wing Designed to Simplify Small Plane," *The Volunteer*, April 6, 1945.

Service Manuals

Five new service manuals released by Eclipse-Pioneer are numbered 21, 30, 43, 72, and 82. Manual No. 21 deals with solenoid relay Type 987, Model 3, Style A. It contains a parts catalog in addition to instructions on the installation, operation, and overhaul of this relay.

Manual No. 30 refers to the installation, service, maintenance, and overhaul of vane-type engine-driven air pumps (Types 610 and 692). It also incorporates a parts catalog to facilitate the procurement of replacement parts, as well as exploded-view drawings showing the complete breakdown of all procurable parts and subassemblies.

Instructions in Manual No. 43 refer to series No. 43 combination electric inertia and direct-cranking starters (Types 444 and 915). The illustrated sections of the booklet give details of installation; operation; service, inspection, maintenance, lubrication; disassembly, cleaning, inspection, repair and reassembly; and test procedure. A parts catalog is appended.

Manual No. 72 features d.c. generator control panels Types 323 and 340. Advice regarding installation, operation, and overhaul is supplemented by numerous illustrations and a parts catalog.

Directions for the installation, service, maintenance, and overhaul of engine-driven single-voltage d.c. generators Type 1381 are contained in Manual No. 82. The usual parts catalog and instructive drawings are included. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*

Photography Helps Build Planes

Focusing the Camera on Industry. Gene Henkel. Contributions of photography to various phases of the aircraft manufacturing industry are surveyed. This article briefly outlines some of the applications of photography in the metallurgy, quality-control, chemical and other research, fuel-testing, engineering, plant-protection, and sales departments. Among the photographic equipment described are a Leitz Metallograph and the photomicrographs it produces, a Leitz Panphot, a Densitometer, spectographic devices, and equipment for X-ray photography. *The Pegasus*, May, 1945.

Financial Survey

Airline Finance is the title of an extensive study conducted by a group of banks and life insurance companies, to make available to the aviation industry and to financial institutions data concerning future financing needs of the air lines and methods for meeting their

A MODERN MISSION OF MERCY

New Bell Helicopter Plays Major Role In Saving Lives of Ice Fishermen Marooned on Lake Erie

Actual Photograph, Taken During Lake Erie Rescue, of the Part Played by the Bell Helicopter

Planes, Boats Join to Save Four in Lake

Helicopter Flies Two To Safety From Ice; Coast Guards Rescue Boy, 11, Grandfather

A Bell Aircraft helicopter,

THE unique qualities of the new Bell helicopter — its ability to do things impossible for any other type of aircraft — have already been dramatically demonstrated in two emergency mercy missions.

Two fishermen marooned on a spring ice floe in Lake Erie were rescued by the versatile aircraft when all other means of reaching them had failed. Earlier, when Western New York was weather-locked by the worst winter in history, the Bell Helicopter carried a doctor to the aid of an injured pilot who had bailed out of his crippled plane and was snow-bound by drifts ten feet high.

These two mercy missions demonstrate one of the helicopter's special capacities. Because it can fly in practically any kind of weather — forwards — backwards — up — down — sideways... hover over a given spot or land on a small plot of ground, the helicopter will also have many other peace-time applications and advantages over other forms of transportation.

At first it may have such specialized uses as rescue work, cargo transport, forest fire patrol, ambulance service, crop dusting, pipe line patrol and other industrial and commercial applications where the most important thing about the helicopter will be its unusual utility.

Right now, Bell Aircraft's interest in the helicopter is primarily in its future development. The production of all our plants is still one hundred percent geared up to a victorious and early ending of the war — building fighter planes at our Niagara Frontier Division, ordnance materials at our Burlington Division, and B-29 Boeing designed Superfortresses at our Georgia Bomber Plant.

A booklet describing the Bell Helicopter will be mailed without obligation. Write the Bell Aircraft Corporation, 2050 Elmwood Avenue, Buffalo 7, New York.

★ *Buy War Bonds and Speed Victory* ★

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

NIAGARA FRONTIER DIVISION
Buffalo and Niagara Falls, N. Y.
Airacobra (P-39) and Kingcobra (P-63)—Fighters
Airacomet—America's First Jet Propelled Plane
The Bell Helicopter

ORDNANCE DIVISION
Burlington, Vt.
Flexible Gun Mounts and other ordnance materials

GEORGIA DIVISION
Marietta, Ga.
B-29 Boeing Designed Superfortress

© *Bell Aircraft Corporation*

future capital requirements. It contains estimates of the expected growth and probable capital needs of the air lines and describes various financing arrangements that are being developed to meet these needs. The study refers to medium-term lending, of primary interest to banks, and longer-term lending, of interest to insurance companies. Methods of analyzing air-line operations from the standpoint of the lender are presented and various feasible ways of financing air lines through the use of equipment trusts, conditional sales, and chattel mortgages are discussed.

The results of the study indicate the probability that by 1950 the domestic air lines will have a volume of approximately 8,000,000,000 passenger-miles as compared with 1,600,000,000 in 1943, and that the gross operating revenues of the air lines in 1950 will reach $500,000,000. It is estimated that to serve the indicated traffic the domestic air lines will require flying equipment and spare parts valued at approximately $300,000,000 and an investment of over $100,000,000 for nonflying equipment, in addition to working capital, which would increase the total domestic requirements within the next 5 years to approximately $500,000,000. Although the pattern of international air traffic is not entirely clear, it is estimated that another $250,000,000 would be required for the expansion of foreign operations. *Bankers Trust Company, The Mutual Life Insurance Company of New York, The Chase National Bank, and The New York Trust Company.*

Machining Processes

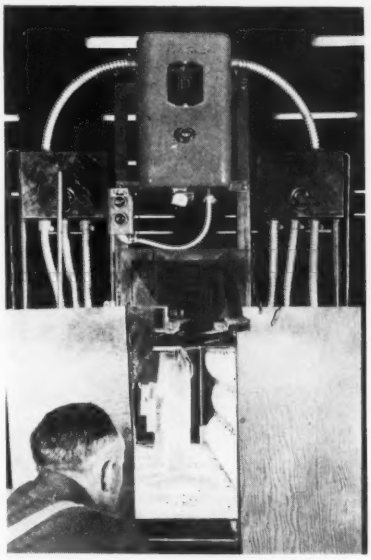
Bulletin No. 66 is titled "The Machining of Ampco Metal" and contains twelve pages of text, photographs, and diagrams. It describes various phases of machining, gives a table of recommended lathe feeds and speeds, and discusses tool design and inspection. The information pertains particularly to the machining of Ampco metal and aluminum-bronze alloys. *Ampco Metal, Inc.*, Milwaukee.

Precision Instruments for Gage Inspection

Search for Millionths. A survey of the precision equipment used in Bell Aircraft Corporation's Gage Inspection Laboratory. In the descriptions of the functions of the various instruments the activities of this Laboratory are indicated. *The Bellringer*, April, 1945.

Procedure for Contract Terminations

Manual on Contract Terminations. Issued as of April, 1945, this is a revision of the company's original manual on contract terminations. It includes, for the information of vendors, a general outline of the essential steps to be followed in terminating contracts, a step-by-step review of the procedure, an analysis of the departmental functions in the process, copies and explanations of the Government forms to be used, and advice regarding the disposition of termination inventory. *Jack & Heintz, Inc.*, Cleveland.



An infrared lamp bank, similar in miniature to those used in the quick-drying of automobile body paint, has been introduced by Studebaker to make possible zero fits with aircraft-engine reduction driving gears. In operation near the beginning of the assembly line, the tunnel-like oven heats the part to 500°. This expands the gear so that it can be installed on the crankshaft. On cooling, the metal shrinks to its normal size. Previously, a hot oil bath expanded the reduction driving gears. The new process is more efficient and more economical and eliminates the noxious odor of the hot oil. With the oil dip, four pairs of asbestos gloves were required daily. The same number of gloves will last 2 weeks with the dry heating method.

Aeronautical Parts Catalog

Catalogs Nos. A-103, A-103-2, A-103-5 are revised sections containing detailed specifications of standard parts designed to comply with Army-Navy Aeronautical Specifications. The first refers to terminals; the second to thimbles, bushings, shackles, turnbuckles, and turnbuckle assemblies; and the third to pins, rivets, and clevis-rod ends. Drawings and tabulated specifications are given for the various products mentioned. *Aviquipo Manufacturing Corporation*, New York.

Aero Research Technical Notes

Testing Glued Wood Joints. One of a series of bulletins describes the test methods originated in the work done by the Adhesive Research Committee some 25 years ago, which have been considerably improved in recent years by the Forest Products Research Laboratory at Princes Risborough. The method of making joints in which the surfaces are brought into contact with each other is described in British Standards 1203 and 1204. The test specimens consist of slips 1 in. wide by $4\frac{1}{2}$ in. long by $\frac{1}{8}$ in. thick, made from rotary-cut home-grown beech veneer and joined with an overlap of 1 in.

Detailed instructions are given for the preparation of the specimens and for the jigs and other apparatus used in making the tests. These are followed by specific directions for the preparation of the gap joints, including the temperatures, pressures, and time periods, supplemented by information about the testing of the joints and a discussion of the fractures resulting from the tests.

Additional information is given in text and tables about the British Standards for synthetic adhesives for wood. *Bulletin No. 28, Director of Research and Development, Aero Research Limited*, Duxford, Cambridge, England.

History of Aeronautical Radio

Voices in Flight. Harryette Creasy. The second in a series of articles about the history of the use of radio in aeronautics traces the origin of the application of radio for communication with aircraft in flight. It describes what is credited as the first transmitter, developed by officers of the Royal Flying Corps in 1915, and outlines the improvements that were made by other R.A.F. officers and officers of the Signal Corps of the U.S. Army. The apparatus resulting from the experiments by the Army, Navy, and American manufacturing concerns is described, as well as the numerous tests conducted during the development and improvement of the equipment and the methods of using it. *Bendix Radio Engineer*, April, 1945.

British Standards for Synthetic Adhesives

Synthetic Resin Adhesives for Wood. The British Standards Institution has issued two new specifications for synthetic resin adhesives for wood. British Standard 1203 provides the method for test and technical details of synthetic resin adhesives of the phenolic and aminoplastic types intended for the manufacture of flat or curved plywood. Details are given about close-contact adhesives for use either hot or cold in liquid, powder, or film form.

British Standard 1204 refers to cold-setting synthetic resin adhesives for constructional work in wood. It provides for adhesives of the phenolic and aminoplastic types intended for the manufacture of wood structures or assemblies. Particulars are given of close-contact and gap-filling adhesives in liquid or powder form. The two specifications are combined in a single booklet of 26 pages. *British Standards Institution*, London, 2*s*.

Past, Present, and Future Beechcraft Planes

Looking at the Record. This pictured compendium of airplanes manufactured by Beechcraft tells something of the uses to which each type has been applied. While prewar and wartime uses are depicted, two of the planes that will be

FOR AIRCRAFT ENGINES...AN AIRCRAFT SPARK PLUG

Day in....Day out

they deliver...

BG

CERAMIC-INSULATED

SPARK PLUGS

TODAY, BG ceramic-insulated spark plugs are giving outstanding results — in the same way that BG mica-insulated spark plugs have demonstrated distinctive quality in dependable, economical performance for over a quarter of a century.

BG

THE BG CORPORATION • 136 West 52nd Street, New York 19, N. Y.

Manufacturers of both mica-insulated and ceramic-insulated aviation spark plugs.

Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders

availa
livery
Corpo

Curr

List
tive S
standa
the A
terials
tions
nonm
use, a
eral
specifi
omme
terms
sectio
cordi
ties f
Amer
Philad

Kle
8-page
about
phosp
nance
folder
shop s
chemi
engine
of ph
power
pound
Chem

A
event
and 1
tabul
into
world
in avi
necte
lines.

We
let of
nical
of the
joints
econo
photo
welds
tables
weldi
weldi
Hoba

Au
26th e
about
figure
tions
of wa
parts.
parts
the o
from
1944,
$4,25
It is

available for postwar commercial delivery are also shown. *Beech Aircraft Corporation*, Wichita, Kan.

Current List of A.S.T.M. Standards

List of A.S.T.M. Standards and Tentative Standards. A list of the current standards and tentative standards of the American Society for Testing Materials is divided into three main sections referring to metallic materials, nonmetallic materials for construction use, and nonmetallic materials for general use. The standards consist of specifications, methods of testing, recommended practices, definitions of terms, charts and tables. In each main section the information is classified according to the materials and the properties for which the tests are applied. *American Society for Testing Materials*, Philadelphia.

Metal-Cleaning Materials

Klem Kleaners are described in an 8-page booklet containing information about processes for cleaning, derusting, phosphatizing, soldering, and maintenance of metals and metal parts. The folder is written for purchasing agents, shop superintendents, factory managers, chemists, metallurgists, and process engineers. The processes explain the use of phosphoric acid cleaners, alkali power-wash, steel-tank cleaners, compounds, and paint removers. *Klem Chemical Works*, Detroit.

News Review

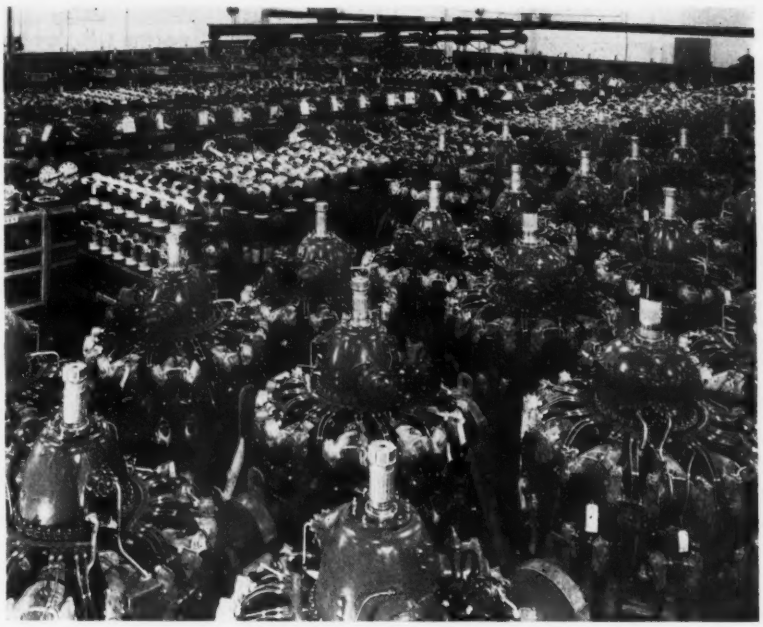
A Quick Look Back. Outstanding events that took place between 1927 and 1944 are noted chronologically in tabular form. The tabulation is divided into three sections, one devoted to world events, the second to highlights in aviation, and the third to events connected with Pennsylvania Central Airlines. *PCA News*, April, 1945.

Welding Guide Book

Welder's Vest Pocket Guide. A booklet of 20 pages contains brief nontechnical descriptions of the characteristics of the different welding arcs, types of joints, and instructions for correct and economical welding procedure. It shows photographs of correct and noncorrect welds, with tabulated comments, and tables and charts for tracing troubles in welding equipment. The standard welding symbols are also included. *Hobart Brothers Company*, Troy, Ohio.

Automobile Statistics

Automobile Facts and Figures. The 26th edition of a booklet giving statistics about the automobile industry contains figures and charts showing the contributions of that industry to the production of war materials, including aircraft and parts. A chart shows that aircraft and parts comprised the largest portion of the output of the automobile industry from the latter part of 1942 to the end of 1944, reaching a peak of approximately $4,250,000,000 in the middle of 1944. It is also shown in tables and charts that aircraft comprised 45 per cent of the total deliveries of the automobile industry in the second quarter of 1944, compared with 37.9 per cent in the corresponding period of 1943, and 28.5 per cent in the second quarter of 1942. Other pages of the booklet contain detailed statistics referring to the other types of military equipment produced and about the economic influence of automotive vehicles. *Automobile Manufacturers Association.*



Finished Pratt & Whitney Double Wasps awaiting shipment from East Hartford, with other parts ready for the assembly lines in the background.

Catalog of Hydraulic Products

Pressurized Power and Controlled Flow is an illustrated booklet of 28 pages containing brief descriptions of hydraulic products designed for general industrial use, including aircraft applications. A section contains information about the use of hydraulic power in airplanes for the operation of controls, flight equipment, and for handling fuel and oil. Another section describes Pesco air pumps and their use in connection with controlled flow and power. *Pesco Products Company Division, Borg-Warner Corporation*, Cleveland.

United Aircraft's War Record

A Pictorial Review of United Aircraft Corporation at War. Some of United Aircraft Corporation's achievements in meeting wartime needs for its products are traced by means of a series of pictures depicting wartime methods of producing aircraft and components. Four charts mark the progress of plant facilities, personnel, shipments, and net profits during the years from 1939 through 1944. Several other charts show the percentage of Pratt & Whitney engines and Hamilton Standard Propellers used on various categories of U.S. military aircraft. *United Aircraft Corporation.*

Pavement Materials and Methods

Surfacing with Tarmac. Fourteen types of paving treatments are described in a 16-page brochure. Advantages of each type of treatment and methods of application are discussed. Tables show Tarmac and standard road-tar designations, applications, temperatures, and uses, as well as recommended aggregate graduation.

Among the methods related is the soil-stabilized base course which is used where there is a scarcity of suitable aggregate for standard types of construction and when the cost of importing aggregate is excessive. Double surface treatment with cold and hot applications is explained. Also discussed are road repairs, prime coating, drag-leveling course, mulch treatment, E-Z mix, road mixes, retreatments and seal coats, penetration macadam, and hot-lay tar concrete. *Koppers Company, Inc.*, Pittsburgh.

Rubber Adhesives

B. F. Goodrich Natural and Synthetic Rubber Adhesives. A new booklet on natural and synthetic rubber adhesives includes directions for the application of natural and synthetic rubber cements. It also describes synthetic rubber cements designed to meet bonding requirements for synthetic rubber products, giving instructions for their use.

A section of the new publication is devoted to discussion of how to choose the right kind of cement for various applications. The differences between the vulcanizing and nonvulcanizing types of rubber cement are indicated and a table contains data on cement weights, colors, and base materials used. Many of the general applications for rubber cements are listed in an alpha-

betical table, which includes the designation by number of adhesives recommended for successful bonding in each case. *The B. F. Goodrich Company.*

Electrical Equipment

Electro-Mechanical and Electrical Controls. Company products and services are illustrated and briefly described in a broadside. The equipment depicted includes linear and rotary actuators, flexible shaft systems, couplings, screw jacks, motors and power units, flexible shafting, and automatic and remote controls. *Lear Incorporated*, Piqua, Ohio.

Diesel Engine Industry

The Story of the Diesel. This booklet on Diesel engines is written in nontechnical language. In brief terms it explains the operating principles of Diesel engines, their fields of application, and their advantages. It also reviews the growth of the Diesel engine industry, discusses the postwar future of these engines, and tells who manufactures them. *The Diesel Engine Manufacturers Association*, Chicago.

Fuel Storage and Handling Systems

Two bulletins offer information of interest to those concerned with the handling of fuels and the separation of water from petroleum products and oils. The first bulletin describes the Flotrol systems for storage and delivery of petroleum products, giving data about a hydraulic system, pumping systems, the applications of the systems, and the Excel-so water separator and filter. The second leaflet is a reproduction of the section on water separation equipment and tells how water may be eliminated from fuels in tank-truck refuelers, airport fueling systems, bulk storage plants, loading racks, refineries, and industrial and chemical plants. The manufacturer was formerly known as Aqua Petroleum Systems. *Flotrol Systems, Inc.*, New York.

Electronic Tubes

Taylor Custom Built Tubes: 1945 Catalog and Manual. A catalog containing information about all tubes manufactured by this company, including those that have been in production since prewar days as well as those that have been developed as a result of the war needs. Some 22 pages are devoted entirely to tube characteristics and a large portion of the catalog contains technical information on transmitters and tubes. *Taylor Tubes, Inc.*, Chicago.

Air-Line Operation in the West Indies 1934–1944

KLM's Caribbean Decade. In a loose-leaf pictorial folder the story of the operations of Royal Dutch Airlines in the West Indies is traced from December, 1934. It is related how, in its first 10 years of existence, the West Indies Section expanded from an 80-mile shuttle route to a 5,180-mile air network, with corresponding developments in service, efficiency, equipment, facilities, personnel, etc. Highlights in the company's progress are reviewed on a year-by-year basis. *K.L.M. Royal Dutch Airlines.*

Plastic Materials

Du Pont Plastics. An 8-page pamphlet provides a digest about the plastics manufactured by du Pont. It includes data about the forms, applications, and properties of these plastics. Among the products examined are nylon molding powder, polythene, Lucite, Butacite, Pyralin, Plexiglas, Fluorothene, Viscacele. *E. I. du Pont de Nemours & Company, Inc.*

Welding and Cutting Equipment

Setting up a Victor Welding or Cutting Unit. Illustrated instructions are given for the assembly and operation of a welding or cutting outfit. These are supplemented by suggestions about the selection of nozzle and tip sizes for various metal diameters to be welded or cut. The listing of a few important precautions serves as a guide to the avoidance of hazardous practices in connection with welding and cutting equipment. *Victor Equipment Company*, San Francisco.

Manufacturing the JRM Mars

Giants Take Form. This article consists of a series of notes concerning the manufacture of the JRM Mars. They tell how, for fabrication purposes, the airplane is divided into three major sections—the hull, center wing, and outer wing—and briefly describe procedures that take place at each fabrication stage. The article also gives some idea of the functions of the Tool Engineering groups in the production of this aircraft. *The Martin Star*, April, 1945.

Performance-Data Sheet

Beechcraft 18S Specifications. A 4-page data sheet contains a brief description and specifications of the Beechcraft all-metal, twin-engined model 18S. It describes the engines, dimensions, instruments, and equipment of that airplane and gives standard performance characteristics. These are stated on the basis of standard atmosphere without external deicers, radio, or other drag-producing items which may be added to the airplane upon order of the purchaser. The specifications include weights, mileage, pay load, and other factors. *Beech Aircraft Corporation.*

Straps and Clips for Electrical Harnesses, Etc.

Adel Straps & Clips for Electrical Systems. The design, construction, and applications of various clips and straps for electrical systems are described and illustrated. Included in the bulletin is information about the company's No. 650, 651, and 654 harness clips with lock-ends and beaded cushions; the No. 666 harness clip with lock-latch and beaded cushion; the No. 701 support clip for Fenwall Fire Detector; the No. 2765 rubber grommet for electrical adapter clamp; and the No. 668 series of harness straps. *Adel Precision Products Corporation*, Burbank, Calif.

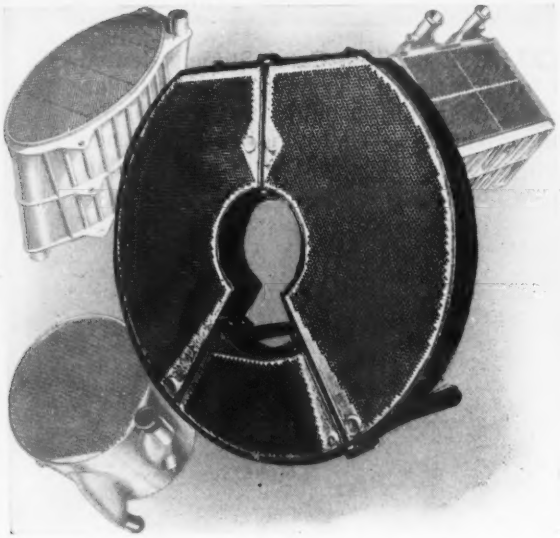
Manufacturing Articles from Thermoplastics

Fabricating Methods for Lumarith, Celluloid and Similar Thermoplastic Materials. Machinery, equipment, and procedures for manufacturing products from Lumarith, celluloid, and similar thermoplastic materials are reviewed. Data are presented on primary cutting, secondary cutting, and fabricating of film and sheet stock. Processes of finishing, molding, and electrostatic heating are described. Illustrations show typical applications, while tables of general properties are included as well as information about the types and forms in which thermoplastic materials are available. *Celanese Plastics Corporation*, New York.

Alloys for Low-Temperature Welding

Eutectic Low Temperature Welding Alloys. A 4-page folder explains the nature of Eutectic low-temperature welding alloys and the uses of Eutectic rods in the production welding field. Specific applications and uses of the various rods are noted, together with specifications on their design and procedures. A full-page assortment chart is included to aid engineers, technicians,

G&O
Radiators
30th Year
ENGINE COOLING
RADIATORS
•
OIL COOLERS
The G&O Manufacturing Co.
NEW HAVEN, CONNECTICUT



HOW ALUMINUM BRAZING SIMPLIFIES ODD SHAPES

Until recently heat transfer units have been complicated by special reinforcements to give them strength in unusual shapes. At high temperatures the soft solder, which bonds copper tubes to their shells and to each other, could not stand the severe stresses set up by pressure, vibration and shear in *unusual* shapes, unless other weight-increasing supports were added.

ALUMINUM BRAZING CHANGED ALL THAT

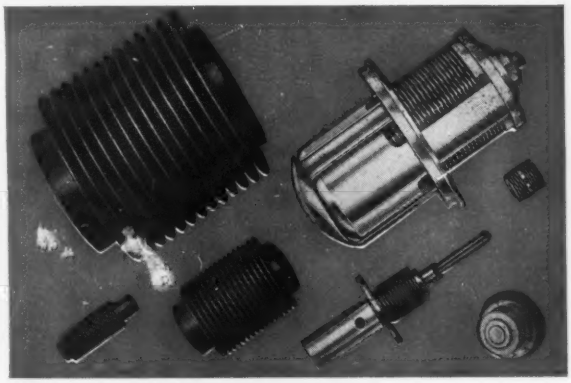
Discovery of a way to braze thin-walled aluminum tubes to aluminum header plates and shells made simply constructed odd shapes possible, for three reasons:

1. Aluminum alloy bonding material defies temperatures, pressures and strains several times higher than soft solder can stand.
2. Heat-treatable aluminum alloy tubes, header plates and shells stand temperatures and pressures that use copper to anneal and weaken.
3. Aluminum's weight being ⅓ that of copper affords other obvious advantages to designers of products incorporating heat transfer units.

That's why USAAF designers were quick to take advantage of Clifford's discovery and put Feather-Weights to use in a number of their aircraft models.

POSTWAR PLANNING

Now war orders occupy 100% of Clifford's production . . . but inquiries and suggestions about postwar applications of all-aluminum heat-transfer units to automotive, heating, cooling and ventilating fields are welcomed. *Clifford Feather-Weights . . . Save ⅔ the weight . . . same size and shape.* Clifford Manufacturing Co., 560 E. First Street, Boston 27, Mass.



IN HYDRAULICALLY-FORMED BELLOWS

the metal has to be right

Metallic bellows can be made four ways:

1. Built up from a number of sections.
2. Mechanically spun from a welded tube.
3. Mechanically spun from a seamless tube.
4. Hydraulically formed from a seamless tube.

The first and second are as strong as their metal and joints; the third as its tool-scratched metal; the fourth as its metal only.

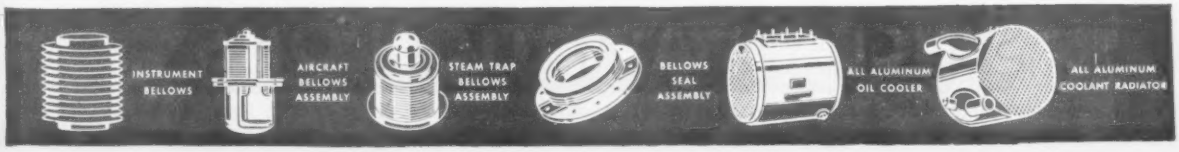
In hydraulically forming a bellows, no spinning tool touches its surface. It's made by forming the paper-thin walls of a metal tube between the plates of a collapsible die by means of internal hydraulic pressure. And since that pressure is much higher than any pressures it will meet in service, any bellows that survive the forming process must be metallurgically sound.

Therefore, to make hydraulic forming practical the metal from which the tube is made must be free from slag and scale inclusions . . . and the tube must be free from draw die marks, variations in wall thickness and faulty crystalline structure.

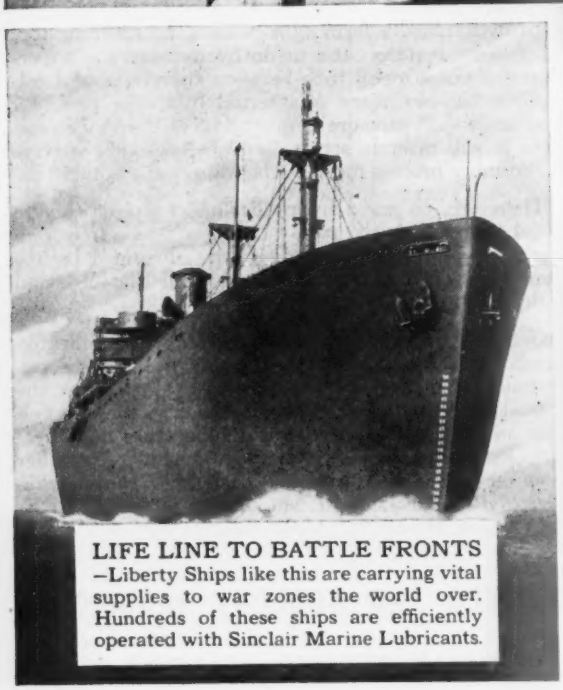
Clifford, being the first to produce hydraulically-formed bellows for industry, not only realizes the importance of metal selection, but also appreciates the critical nature of all processes involved in making bellows assemblies for controlling temperature and pressure; for sealing against pressure leakage; or for other exacting uses. *First with the Facts on Hydraulically-Formed Bellows.* Clifford Manufacturing Co., 560 E. First Street, Boston 27, Massachusetts.

CLIFFORD *Feather Weight* **OIL COOLERS AND COOLANT RADIATORS**

HYDRAULICALLY-FORMED BELLOWS HYDRON Metal Bellows



FLYING MADE EASY—Carol Stone, talented daughter of famous actor Fred, steps into an Ercoupe. Beginners have learned to fly this spin-proof plane in 5 hours or less. Flying or driving, when war's over, you'll have new war-developed Sinclair Gasoline to help your motor always do its best.



LIFE LINE TO BATTLE FRONTS—Liberty Ships like this are carrying vital supplies to war zones the world over. Hundreds of these ships are efficiently operated with Sinclair Marine Lubricants.

SAVE *YOUR* CAR from the junk yard. Thousands of worn-out cars are junked daily. Proper lubrication saves wear—helps save cars. See your Sinclair Dealer regularly.

SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL *WRITE* SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

and welders in selecting the proper rod for their particular job. *Eutectic Welding Alloys Company*, New York.

Financing Personal Flying

Aircraft Financing. This manual presents a summary of information about the various types of financing pertinent to personal flying. A large proportion of its contents is devoted to illustrations of the basic forms used in connection with aircraft financing. Procedures for making direct loans to individuals, financing via dealers and retailers, and financing dealers' floor planning requirements are among those considered. *American Bankers Association*, New York.

Production and Maintenance Suggestions

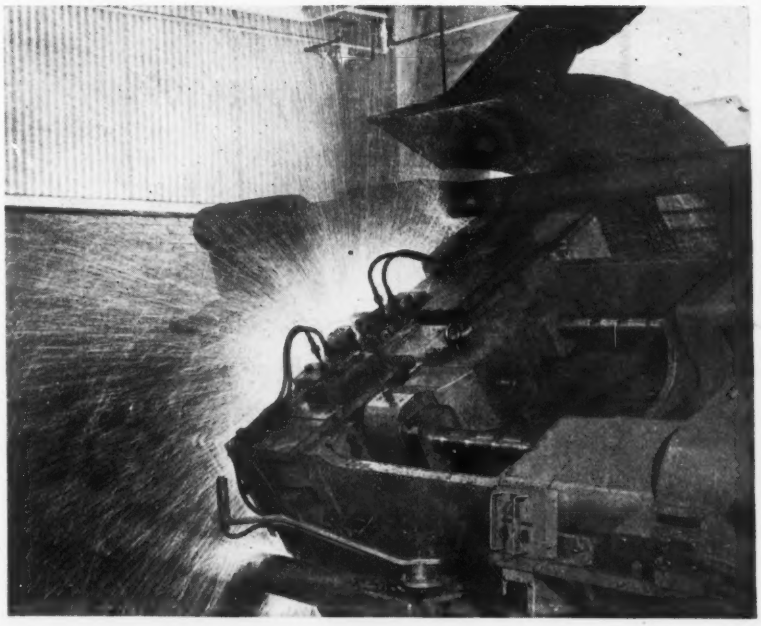
Eclipse-Pioneer Flight Control, April, 1945. (1) Simplified method of assembling an alternator stator saves work hours; (2) improved method of hobbing the sextant frame, eliminates two operations and effects an economy of man-hours.

Canadian Car Journal, March, 1945. (1) Drill-press tool for filing radii on Masonite and steel form blocks replaces hand method and performs operation in one-fourth the time formerly required; (2) wrench for removing wing nuts from sump of aircraft oil tank eliminates breakage; (3) special wrench for use on inaccessible hinge bolt; (4) circular saw with attached depth gage facilitates removal of damaged sections in wooden aircraft parts; (5) new method of drilling hard rubber to make rubber fair-leads; (6) tool for holding undercarriage latch cable while soldering a ball fitting on the cable enables one man to do job instead of two.

The Bellringer, April, 1945. (1) Screwdriver and vise for removing tight-fitting screws in machine-gun oil tubes; (2) dummy strut for fitting and adjusting nose-wheel flipper doors saves man-hours; (3) air-powered hand tool for rounding edge of Plexiglas component protects plastic form from scratches and prevents cutting the edge too deeply; (4) assembly fixture for landing-gear main-wheel spindles assures proper fit between the spindle and race; (5) combination jack-and-screwdriver tool for installing Phillips-head screws inside the carburetor air scoop maintains pressure against the screw, facilitates insertion, and saves both time and material.

Convair News, April 6, 1945. Set of three gages for measuring rudder torque tubes for the empennage eliminates less efficient hand method of determining dimensions of the component.

American Stove Company Aircrafter, April 6, 1945. (1) Jig for simultaneous routing of both sides of armor plate increases production and results in more uniform job; (2) jig for centering cable clip on primary cowls obviates layout work; (3) box tool holder for use in making various kinds of punches for dies saves time; (4) new method of inserting Clecos for spot welding of fillets eliminates necessity for removing Clecos and saves 75 per cent of time needed for spot welding.



At the Columbus Plant of the Curtiss-Wright Corporation, this flash-welding machine, claimed to be one of the largest in the country, can make welds almost instantaneously under a pressure of 120 tons. The machine is capable of taking two hollow forgings of the hardest steel, each 6 in. in diameter with a wall 3/4 in. thick, and, in 2 min., heat and weld the pieces together.

Eastern Aircraftsman, April, 1945. Welding of a dowel on a base plate so that bellcranks can be mounted and turned in any position for welding saves labor and eliminates rejections.

Hamilton Standard Blade, April 5, 1945. (1) Installation of a caliper arrangement completely governing the operations of the machine used in rough-grinding propeller blades eliminates scrapping and speeds operations; (2) placing two cutters side by side on a milling machine enables the combination of two operations and the use of one machine where two were formerly required.

Douglas Tulsa Airview News, April 6, 1945. (1) Drilling seat for poppet deeper eliminates chattering in check and relief valve; (2) unit for testing autopilot servo mechanism is more accurate and keeps the servo protected at all times; (3) device for indicating defect in the servo amplifier of aircraft's wiring saves man-hours.

Noorduyn Tale-Spin, April, 1945. (1) Adjustable arm on lever control of shear eliminates one operator and effects greater speed and safety; (2) holding fixture saves time and labor in trimming stiffeners; (3) lever device simplifies the disengaging of eyebolt from lift fitting of wing; (4) holding fixture for cabin door lock eliminates need for holding bushing while welding; (5) straightening block attached to arbor press performs necessary straightening operation after the welding of plug cooling jet; (6) holding fixture for use in drill press operations eliminates safety hazard.

The Menasco Flying M, April 13, 1945. (1) Positive stop on turret lathes replaces old method of using a bolt and eliminates excess scrap and shut-down time for machine repair; (2) adding a chamfering tool to boring bar of main landing-gear cylinder eliminates rehandling the part; (3) improved method on ship guard for mills.

Curtiss-Wrighter, April 20, 1945. (1) Device for locating string clips on fuselage bulkheads; (2) making form joggling dies of hot-rolled steel with adjustable tool steel inserts saves strategic material and enables the use of the same dies for various depths of joggles.

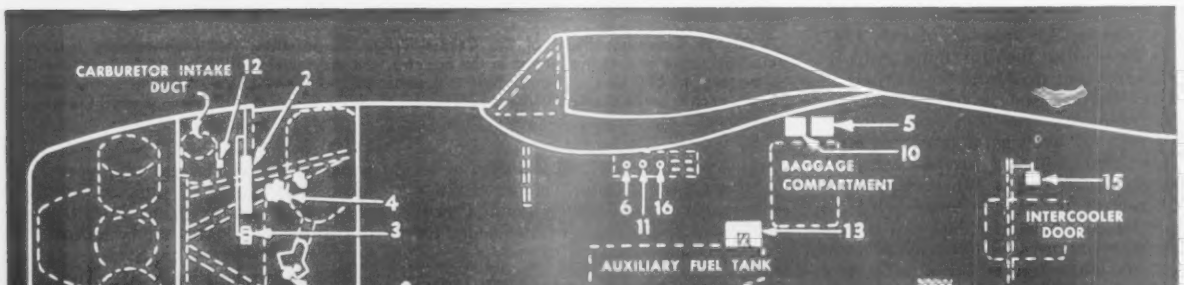
Consolidated Vultee Stinsonair, April 2, 1945. Improved method of pickup welding on fuselage following the box jig.

Bell Aircraft News, April 21, 1945. (1) Cleco sheet-holder repair unit; (2) new method of removing solder from used Cannon and amphenol plugs.

Transatlantic Air News, April, 1945. (1) Special jig device for disassembly and reassembly of mixture controls safeguards against damage to unit and eliminates knuckle bruises for operator; (2) engine-control jig makes the entire replacement of engine-control cables a one-man operation; (3) jig speeds up replacement of cables and rigging of ailerons while eliminating one of two operators formerly required for this job.

G-E AUTOMATIC TEMPERATURE CONTROL PUTS AN END TO EXCESSIVE FLAP DRAG

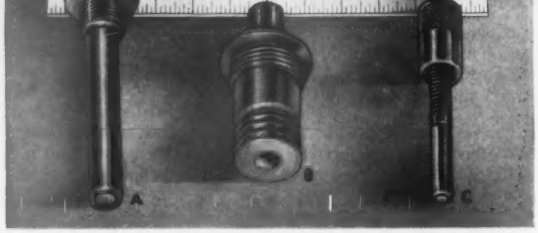
Only 4.6 lbs added . . . u



APPROXIMATE LOCATION OF HEAT-CONTROL UNITS

No.	Name
1.	Thermo-sensitive element — cowl flaps (on cyl. No. 13)
2.	Cowl-flap cylinder
3.	Follow-up rheostat — cowl flaps
4.	Electro-hydraulic valve — cowl flaps
5.	Control box — cowl flaps
6.	Cowl-flap switch
7.	Oil-cooler follow-up rheostat
8.	Oil-cooler motor
9.	Thermo-sensitive element at "Y" drain — oil cooler
10.	Oil-cooler control box
11.	Oil-cooler switch
12.	Thermo-sensitive element — intercooler doors
13.	Intercooler control box
14.	Intercooler motor
15.	Intercooler follow-up rheostat
16.	Intercooler switch

Diagram shows the location of components in a typical application of G-E temperature control. Controllers (the only heavy components) can be located almost anywhere in the ship. All components except thermal elements are interchangeable. The system operates on 24 volts d-c.



The thermo-sensitive elements include: A, used for oil or engine coolant; B, for carburetor air; C, for engine head. The small size of these elements facilitates their location where space is at a premium.

. . up to 40 mph regained

PILOTS FREE TO CONCENTRATE ON FLYING

COMBAT pilots shouldn't have to be continually adjusting the position of cooling flaps and exit shutters. Yet, in the past, that was the only way they could minimize drag consistent with engine cooling requirements. The tendency was to play it safe, leaving flaps and shutters open wider than necessary. The resulting drag caused as much as 10 per cent loss of speed on a 400-mph ship.

It's a different story now, because of G-E automatic temperature control!

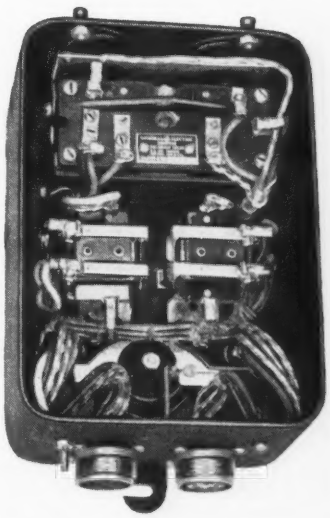
Employing a remarkable new temperature-sensitive material, General Electric has developed a system that *automatically* positions flaps to maintain the most efficient temperature of engines, oil, carburetor air, and coolant. Excessive drag is avoided. So is the danger of overheating. The pilot can devote *all* his attention to other duties.

LIGHT WEIGHT

This new G-E system involves but a slight weight penalty: only 4.6 pounds in the case of engine-head temperature control. It holds temperature accurately, without hunting. It is flexible, being adaptable to almost any type of temperature control, and is easily applied because all components are interconnected electrically.

G-E automatic temperature control is used on important planes now in production, and will be installed on several other new fighter, bomber, and cargo ships. It should be a "natural" for postwar commercial planes from the standpoints of both fuel economy and freedom for pilots.

May we tell you why automatic temperature control and other G-E pre-engineered systems for aircraft can mean substantial savings in engineering man-hours and assembly time for you? *General Electric Company, Schenectady 5, N. Y.*



The heart of the new system is this G-E developed controller. A highly sensitive, polarized relay (in top of case) responds to the signals from the thermo-sensitive elements, energizing power relays (below). The power relays then actuate the flap motor to open or close the flaps. The rate of response is extremely rapid, and the follow-up principle employed insures positive operation without hunting.

Buy all the BONDS you can —and keep all you buy

PRECISION PRODUCTS & ENGINEERED SYSTEMS FOR AIRCRAFT

GENERAL ELECTRIC

674-36-8872

INSTITUTE *of the* AERONAUTICAL SCIENCES

1932–1945

Since its incorporation in October, 1932, as a scientific membership society to advance the art and science of aeronautics, the Institute of the Aeronautical Sciences, in over ten years of service to aviation, has become the representative technical society for the aviation industry and profession. It is the only organization in the United States which brings together all of the sciences and branches of engineering and technology which are applied to aeronautics.

Activities

In this year, coincident with the great increase in aeronautical production and research in the nation's war effort, the Institute is expanding its membership and activities in keeping with the greater demands made upon its services. Beginning with aeronautical students, the Institute has increased the number and activities of Student Branches. Members of the Institute in aeronautical centers are organized in local Sections which hold their own meetings. More of these Sections are being formed this year and additional services provided for members. The Annual Meeting and other national meetings provide forums where specialists in all the aeronautical sciences may present and receive reports on progress made in their particular fields and learn of developments in other fields that have a bearing on their own work. Several annual awards and honors are conferred by the Institute to recognize and encourage outstanding achievement in the aeronautical sciences.

Publications

Papers presented at meetings or submitted to the Editorial Board are published in the JOURNAL OF THE AERONAUTICAL SCIENCES or the AERONAUTICAL ENGINEERING REVIEW. The JOURNAL prints in each issue several full length scientific papers on new research and developments in various fields applied to aviation. The REVIEW keeps members and subscribers up to date on aeronautical news and literature through reviews of new books and periodical articles, government publications, and trade literature and publishes papers on applied engineering and aircraft production.

The AERONAUTICAL ENGINEERING CATALOG, published yearly, is a guide to sources and specifications of materials, parts, and accessories used in the design and production of aircraft, aircraft engines, and parts.

Research Facilities

Through the Aeronautical Archives of the Institute, members have for their use the most complete aeronautical library and reference research facilities maintained by any technical society. At Institute headquarters in New York, the W. A. M. Burden Reference Library of books, reports and periodicals, the Aeronautical Index of subject files, biographic files and bibliography, and the historical and art collections in the Archives are available for study. The Pacific Aeronautical Library at 6715 Hollywood Boulevard, Los Angeles, maintains a reference collection and reading room for members and loans books to company libraries in the area. Through The Paul Kollsman Library, aeronautical books are lent by mail without charge to members anywhere in the continental United States. In addition to a very complete collection of standard aeronautical reference works, the Kollsman Library has available for loan new aviation books as they are reviewed in the AERONAUTICAL ENGINEERING REVIEW.

Membership

In addition to membership in professional societies representing their particular fields, specialists applying their knowledge and experience to aeronautics find membership in the Institute of great value in the contacts made with others engaged in aeronautical work and in the broad coverage of all aeronautical problems furnished through its meetings and publications. All applications for membership are carefully reviewed by the Admissions Committee, which recommends the grade of membership for which the applicant is found eligible. There are advanced grades of membership—Associate Fellow, Fellow, Honorary Fellow—to which members may be elected as their experience warrants. Thus, a member receives due recognition—more valuable because it is given by his colleagues—for his contributions to the progress of aeronautics. New applicants may be elected initially by the Admissions Committee to the grade of MEMBER if they are engineering graduates with at least three years of experience or have had over five years' experience in research, engineering, or other special work applied to aviation; to the grade of Industrial Member if they have acquired a recognized standing in an administrative capacity in the aviation industry; to the grade of Technical Member if they are recent engineering school graduates or are engaged in technical aeronautical work. For those interested or engaged in aeronautics or fields related to aeronautics who wish to participate in the activities of the Institute, the grade of Affiliate is provided. Student Members are admitted by application through Student Branches organized at their schools. Aeronautical companies, as well as individuals, are affiliated with, and participate in, the support of the Institute through Corporate Membership.

Dues

An entrance fee of $5.00 is required of all new members who apply for admission to a grade of membership to be specified by the Admissions Committee (Corporate Members, Student Members, and those who apply specifically for the grade of Affiliate being excepted).

Annual membership dues for the various grades of membership are as follows: Fellows—$15; Associate Fellows—$11; MEMBERS—$9.00; Industrial Members—$9.00; Technical Members—$5.00; Affiliates—$5.00.

The regular subscription price for the JOURNAL OF THE AERONAUTICAL SCIENCES and the AERONAUTICAL ENGINEERING REVIEW is $7.00 and $3.00 per year, respectively. Members may subscribe to the JOURNAL or the REVIEW or both at one-half the regular subscription rates.

Those who are engaged in aeronautical work or who have an interest in any technical phase of aviation will find the services of the Institute to be a necessary aid in keeping abreast of developments in these times of such rapid progress. An application form and further information about membership can be obtained from an Institute member or by writing to the Secretary.

INSTITUTE OF THE AERONAUTICAL SCIENCES

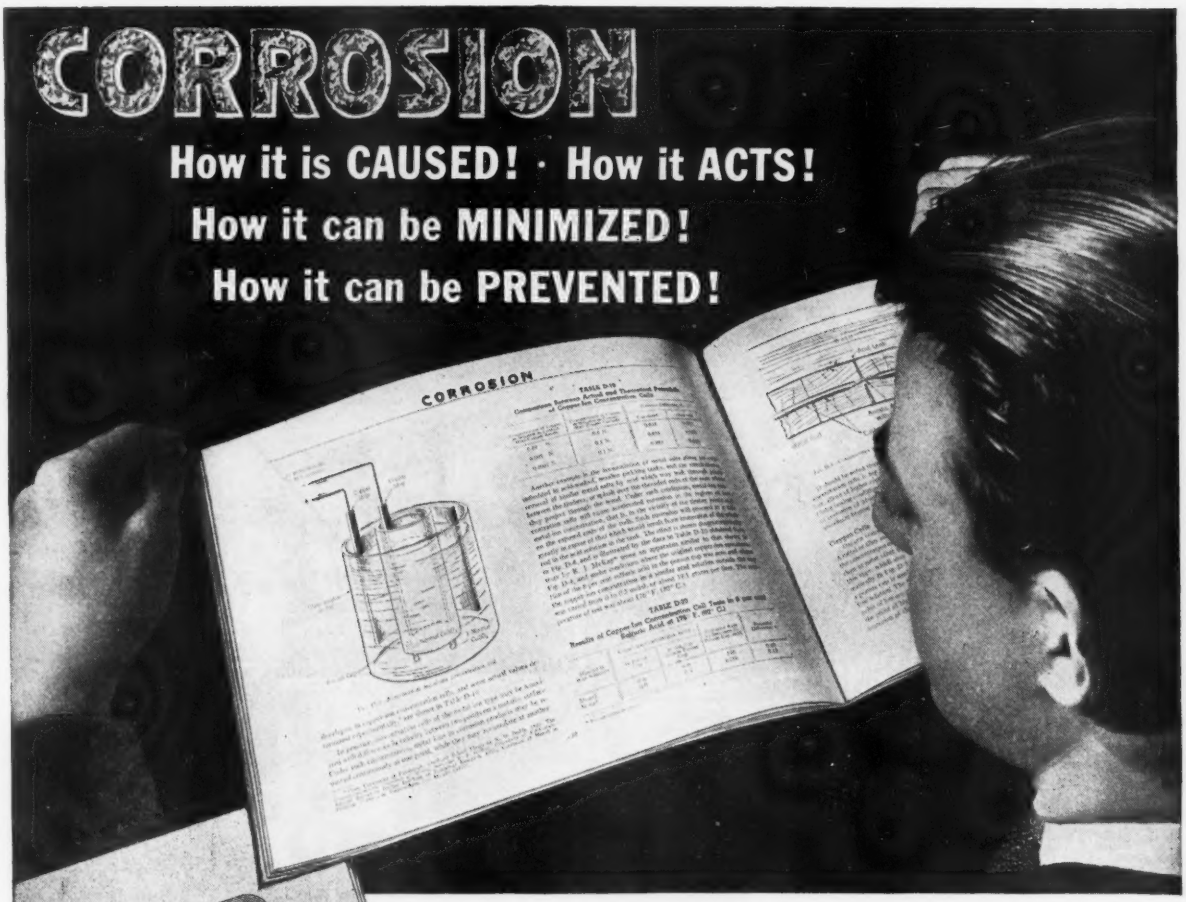
1505 RCA BUILDING WEST

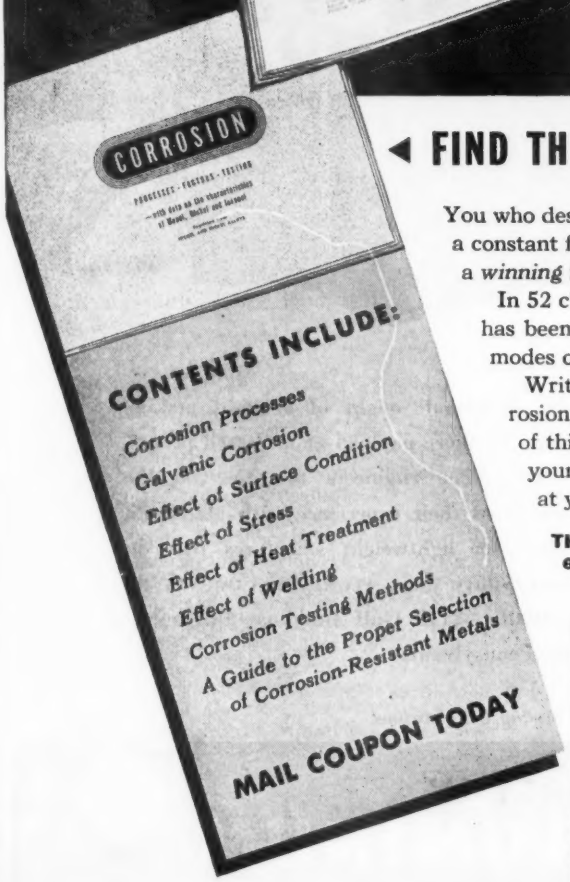
30 ROCKEFELLER PLAZA

NEW YORK 20, N. Y.

CORROSION

How it is CAUSED! · How it ACTS!
How it can be MINIMIZED!
How it can be PREVENTED!





◄ FIND THE ANSWERS IN THIS NEW BOOKLET

You who design, build or operate aircraft and aviation equipment are in a constant fight against corrosion. Here's a booklet to help you make it a *winning* fight.

In 52 clearly written pages, most of what is known about corrosion has been reduced to a logical explanation of its causes, factors and modes of prevention.

Written by a staff of men whose special work is the study of corrosion, this booklet meets the need for an up-to-date understanding of this ever-present threat. So tear out the coupon and send for your copy now. "CORROSION" is a handy reference aid to have at your fingertips whenever you meet the problem of corrosion.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N.Y.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Gentlemen:
Please mail me a copy of your new booklet "Corrosion."

Name.....

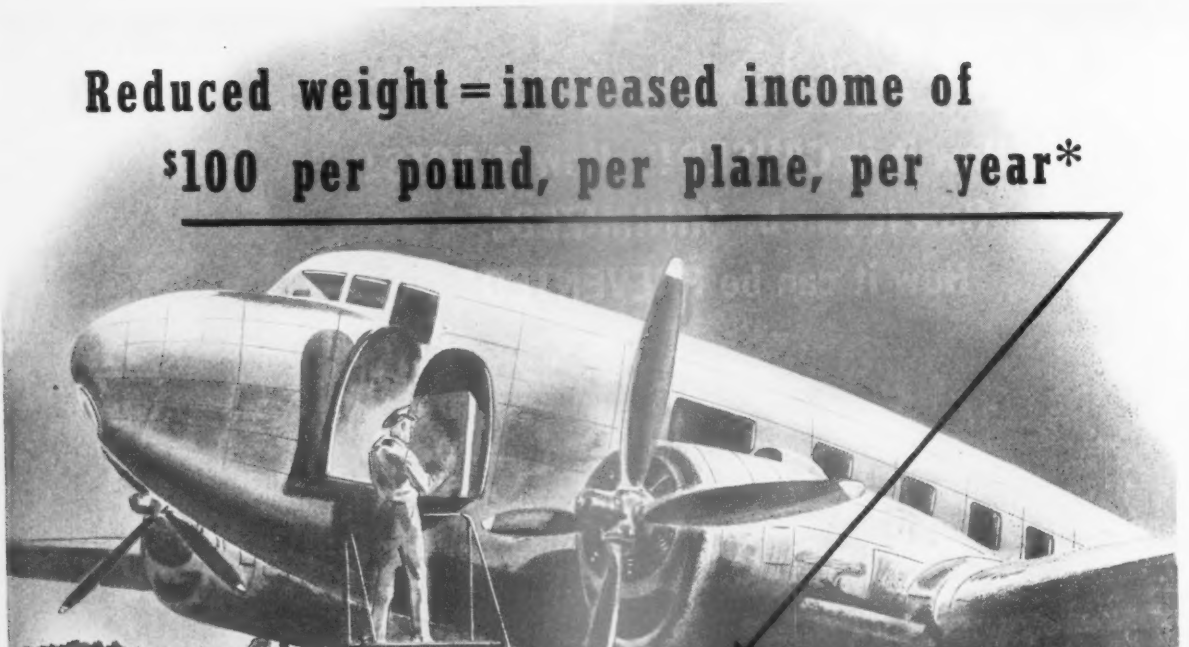
Position.....

A.E.R. 6-45

Company.....

Address.....

Reduced weight = increased income of $100 per pound, per plane, per year*



Cut 100 pounds of dead weight per plane for a fleet of 10 transport planes and you have saved $100,000 a year. Multiply this figure by the life of the plane in commercial operation—and you have a good idea of how important each single pound of weight saving can be.

Reducing the weight of things is our specialty. Alcoa's new, high strength, corrosion-resistant aluminum alloys can cut the structural weight of aircraft, making room for more payload at increased profits.

Ask Alcoa engineers to give you the benefit of their experience with aluminum alloys for lightweight structures that do heavy-duty jobs. ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

**Average saving estimated by 4 leading U. S. Airlines*

ALCOA FIRST IN **ALUMINUM**

From the Industry

Production Technique for Aluminum and Magnesium

On aluminum and magnesium parts, a sequence of operations such as surfacing, boring, milling, and drilling can be carried out at one setting without disturbing the piece or holding fixture, through the use of a new production service technique. A battery of special machines with versatile interchangeable attachments eliminates many of the tools and fixtures used in the usual machining processes, saving up to 50 per cent or more of tool and fixture cost.

These machines permit the mounting of four heads on the master head, at the same time. This makes possible the multiple production of up to four pieces simultaneously. By setting up the machine instead of the job and through coordinating special combinations of heads with Vernier scales built into the machines, precise positioning of the part in relation to cutting tools is possible in all directions. This method provides jig-bore precision between related surfaces whether drilled, slotted, or milled.

Inaccuracies resulting from transfer of parts from jig to jig are eliminated. This permits working to very close tolerances. Extremely difficult jobs not practical with usual machine tool equipment are reported to be handled accurately and speedily. Aircraft Parts Manufacturing Corporation, Des Plaines, Ill.

Safety Splice

A new method for splicing wire rope into slings or various assemblies has been developed. Rendering hand-tuck splicing obsolete and unnecessary, this method is said to produce a neater and more compact splice than is possible by the hand method. The splice is flexible all the way to the terminal and develops 100 per cent of the rope's strength. It does not distort the rope structure and thus maintains equalization of stresses in all strands. The splice applies the load stress in direct line with the pull of the load. It has no seizings to loosen, unravel or get in the way, no wire ends to barb and tear workmen's hands.

Wide open for visual inspection at all times, it may be used with any standard fitting (hook, ring, shackle, thimble, etc.). When the sling or assembly is retired, such fittings may be salvaged and reused. American Chain & Cable Company, Inc., Bridgeport, Conn.

Resin Adhesive for Low-Pressure Bonding

Urac 183 is a new craze-resistant urea-formaldehyde resin adhesive offering improved bonding for intricate wooden parts where the application of high pressure to secure a uniformly thin, durable glue line has heretofore been extremely difficult. The new adhesive, having improved features for low-pressure wood assembly work in aircraft and other applications, is intended to reduce the problem of crazing or fine cracking of the glue which causes deterioration of the glue lines.

Other advantages are stated to be (1) greater storage stability; (2) elimination of amylaceous fillers; (3) control of glue-line hydrogen-concentration factors to values acceptable under U.S. and R.C.A.F. specifications; (4) lower cost; and (5) provision of a hardener system for summer-temperature use.

With Urac 183 in low-pressure bonding, a glue-line thickness up to 0.020-in. may be tolerated. This is of particular value in low-pressure assembly gluing where complex shapes prohibit perfect joining and high pressures are not applicable to insure uniformly thin glue lines. The manufacturer states that the adhesive can be readily mixed by hand or by simple mixing equipment, and, if mixed and used as directed will conform to U.S. specifications AN-G-8 and 52-G-11, and Canadian Government specifications C-27-484, DTD-484, and C-27-335-A.

The adhesive can be used over a wide range of equilibrium moisture content, from 7 per cent to 15 per cent. For Canadian aircraft work it is recommended by the maker for wood having an equilibrium moisture content of 9 per cent to 15 per cent. The adhesive can also be adapted to rapid production by the use of elevated temperatures to speed the cure. Kilns, ovens, strip heating, autoclaves, and heated platens, as well as infrared lamps, may be used to speed production. American Cyanamid Company, Plastics Division.

American Chain & Cable Company's Acco-Lock safety splice.

Fast-Acting Portable Fire Extinguisher

The Alfite Speedex portable fire extinguisher is made in three different sizes, Models 15, 10, and 4, and uses carbon dioxide as the fire-extinguishing agent. The numbers indicate the gas capacity in pounds. The unit is designed to extinguish small oil or electrical fires, with no loss of the extinguishing gas on anything but the fire itself.

The Speedex operating valve lever is directly above the carrying handle. It can be opened instantly by the pressure of the hand grip and as quickly closed by releasing the hand pressure while the operator is changing his position. For continuous operation a D-yoke ring is slipped over the operating lever while it is depressed. American-LaFrance-Foamite Corporation, Elmira, N.Y.

Standard Color Code for Machine Lubrication

Unskilled labor can be effectively guided in applying the right grease or oil to machinery through use of a new American war standard based on a simple system of matching colors. This war standard has been developed through the American Standards Association at the request of the National Machine Tool Builders Association and the War Production Board. The purpose is to facilitate the lubrication service of machinery and also to cut down the increasing amount of damage to machinery in war plants from misuse of lubricants by unskilled labor.

The Color Code for Lubrication of Machinery aims to make the application of the right lubricant so simple that the least skilled employee will not make a mistake. The committee in charge has worked out a basic system of color markings to be applied to the containers of a given lubricant and also to the points where each lubricant should be applied. The lubricating device, such as an oil can or grease gun, and the lubrication fitting to be serviced with it are marked with the same color, either by paint or decalcomania. The service man has only to "match colors" to be sure that each lubricant is being used in the right place.

The new code relates to eight general classes of lubricants, each of which is designated by an identification color. The oils are divided into five classes and

the greases into three. For both oils and greases, there is a "general purpose" class and a "special purpose" class. The three remaining classes of oils are machine-tool spindle oils, gear oils, and hydraulic oils. The third class of grease is for antifriction bearings.

To each class of lubricant a standard identification color has been assigned. Machine-tool spindle oils are identified as a class by yellow-green, Munsell Color Notation GY 7/10. The lubricant containers such as oil drums do not need to be painted all over with the identification color. A clearly visible patch of color, such as a solid 3-in. circle, is sufficient.

When an industrial plant uses more than one kind of lubricant in the same class, the code recommends that distinction between these lubricants be made by the use of different numbers marked on the identification color for the class. The color code is not intended to indicate any of the physical or chemical properties of a lubricant but is intended merely to "route" a given lubricant to the points where it is to be applied.

Copies of the American War Standard Color Code for Lubrication of Machinery, Z47.1-1945, may be obtained from the American Standards Association, New York, $0.20.

Continuous-Cast Bronze

Certain bronze alloys previously available only as sand, permanent mold, or centrifugal castings are now produced by a continuous casting process in mill-length rods. As such they are adapted to fabrication on automatic screw machines and present an opportunity for improved production and large economies. The structure of these continuous cast rods is uniform, the lead content or other secondary constituents being uniformly dispersed in a finely divided state throughout the entire section.

As the name of the process implies, the rod is produced by the continuous withdrawal of metal from the bottom of a casting crucible. The metal is solidified as it leaves the crucible and passes through a suitably cooled die of closely held dimensions. It is guided by driving rolls to a travelling cutoff device that engages at proper intervals to yield sound rods of good surface, uniform diameter, and even length. Dirt and drosses, being light, do not enter the solidifying rod. Gases are eliminated upwards and the molten bath presents a steady hydrostatic head to prevent the formation of shrinkage cavities. Ampco Metal, Inc., Milwaukee.

Hole Cutters

Designed on a new principle, a tool bit created specifically for use in hand braces to cut holes in wood is announced. The construction of the tool includes a center lip that extends back to form a clamp for firmly holding the adjustable blade at the diameter set. The clamp is locked tight by means of a screw. Once locked in the positive wedge-lock V groove, it is reported, the cutter remains securely in place and cannot get out of adjustment.

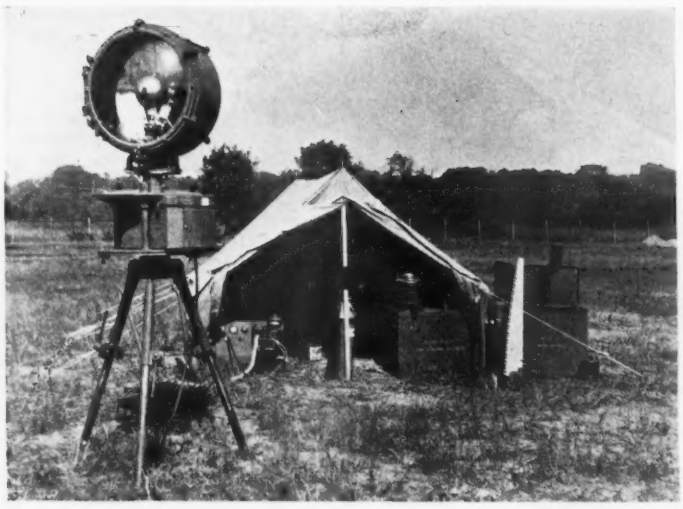
An improved diamond-shaped screw point is said to give longer life by lessening the chance of breakage. The lead screw is threaded finer than is usual for this type of tool. This feature helps pull the bit through the wood, requiring only light pressure to cut quickly and cleanly because the lead screw is continuously and firmly engaged while the adjustable blade is cutting. Two models are available. No. 200-B cuts holes from $^3/_4$ in. to $1^3/_4$ in., No. 201-B cuts all diameters from $1^1/_2$ in. to $3^1/_2$ in. Both tools are equipped with standard square bit-stock shanks.

The manufacturer also produces cutters incorporating similar principles for use in metals, plastics, Dural, fiber, Masonite die stock, hard rubber, and other materials. These models, known as No. 100 and 100-B, are provided with either straight shanks or square bit stocks and in capacities for drilling holes from $^5/_8$ in. to $2^1/_2$ in. Bruno Tools, Beverly Hills, Calif.

Mobile Rotating Beacon

Many improvements have been added to a portable and mobile rotating beacon, now being manufactured for the U.S. Coast Guard, for use as an aid to marine and air navigation.

When you write to manufacturers
whose advertising appears
in the
Aeronautical Engineering Review,
it will be
of interest to the companies
and of benefit to the Institute if you
mention that you saw it
in the
Aeronautical Engineering Review



The Davey Compressor Company's mobile rotating beacon.

The beacon's 24-in. face is now equipped with a variety of snap-on lenses, shutters, and mountings which adapt it to many functions such as an airport beacon, either rotating or non-rotating, a searchlight, a floodlight, a range light, a temporary lighthouse, or a signaling searchlight. A new variable-speed arrangement permits changing the rotating pattern and it is also possible to fix the beacon position for directional use.

Designed primarily to guide and warn sea and air traffic, it can be rushed to the location of a damaged lighthouse or signal buoy, and there establish similar beacon or signal contact. As a directional projector, it can furnish light for ship-to-shore rescues or sea or air emergency landings.

The beacon assembly is housed in the completely enclosed insulated body of a $1^1/_2$-ton truck, which also affords space for the electric generating plant, complete auxiliary equipment, tools, and spare parts, and provides living quarters for a two-man crew. The cover for the roof opening raises and lowers with the beacon, and a handwheel operates the lift, with elevating gears carried in an enclosed support between the truck frame channels.

The beacon can be removed quickly and mounted on a tripod for field use. An 8- by 10-ft. tent is carried to afford a camp setup independent of the truck if necessary. The Davey Compressor Company, Kent, Ohio.

Plastic Sheets for Drawings and Reproductions

Plastic sheets, especially processed from Vinylite for accurate drawings and close-tolerance reproduction, are processed to a standard size of $51^3/_4$ in. by 144 in. Special sizes and surfaces can be supplied upon request. The different types have been designed to insure accuracy for those who are contemplating installing a metal reproduction system and to help every type of industry requiring drafting and reproduction.

In connection with the plastic sheets the maker has developed a system of template or flat-pattern reproduction on a direct-contact basis. Original drawings are made directly on Dyrite, checked for possible errors, and then reproductions for templates, etc., are made from these original drawings. With this process, darkrooms and large developing tanks are unnecessary as an emulsion has been developed that can be used under artificial light. This emulsion can be had in any desired color.

Aircraft uses suggested by the maker are for original loft, instead of metal or wood; for overlay work to take off attaching parts; for visible template work, skins, etc.; and as a reproduction original for the making of templates, etc. Direct Reproduction Corporation, New York.

Portable Light and Power Fixture

Cone-shaped portable light towers designed to bring light, air, and electric service to convenient points within the C-54 fuselages during construction are helping aircraft workers to meet increased schedules for the big transports.

Each tower is 47 in. high, 10 in. in diameter at the top and 18 in. at the base. Ten 40-watt fluorescent tubes are held vertically in each conical reflector and protected by a wire screen.

Air and electrical outlets in the base of each fixture make it possible to use short hoses to the rivet guns and short cords on drill motors. This results in a decided saving in purchase and repair of hose and cord as well as contributing to plant safety since a tripping hazard has been eliminated.

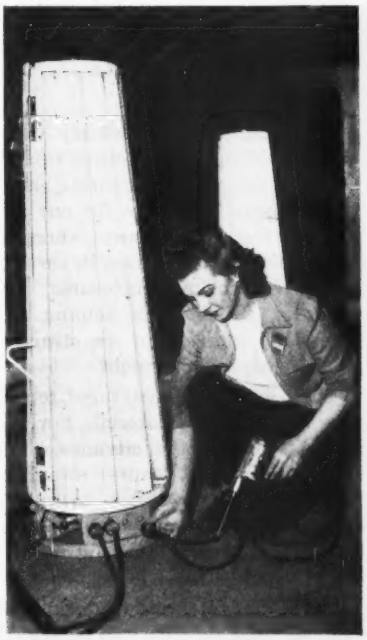
Five units, placed 8 ft. apart, are used in each fuselage and may, if necessary, be connected in series. Douglas Aircraft Company, Inc.

Conversion and Overhaul Centers

To accelerate the transformation of surplus army transports from war to peacetime use, the Douglas Aircraft Company has set up, with Government approval, a system of "Authorized Conversion and Overhaul Centers." To initiate the program Douglas has selected four firms as operators. They are Globe Aircraft Corporation of Fort Worth, Texas; Grand Central Airport Company of Glendale, Calif.; Timm Aircraft Corporation of Van Nuys, Calif.; and Canadair, Limited, of Montreal, Canada.

Under the agreement with these operators Douglas will extend to these licensees full technical aid, supervision, drawings, tools, and its accumulated experience. Douglas will maintain a master schedule of jobs placed or initiated at each center and work referrals will be coordinated in the interests of maximum output and efficiency.

Douglas Aircraft Company has set up six administrative groups to aid the associated companies in details of operational planning, licensees' accounts, quality control, tooling and equipment, data and records, shipments and procurement, and specialized assistance. A Douglas resident representative at each center provides liaison with the home office. All technical data furnished the centers, including drawings, documents, tables and other reports, are serial-numbered and labeled so that predetermined information kits will be available to any other domestic or foreign centers that may be established at a later date. To expedite the conversion program further, Douglas has granted a blanket approval to each center to manufacture parts for installation on



Douglas Aircraft Company's new pyramidal, portable light tower.

★ ★ ★

DU PONT "LUCITE" *flies with them all!*

★ ★ ★

Its excellent optical qualities insure clear vision . . . its ease of forming means fewer "blind spots"

Crystal-clear transparency without distortion and excellent optical qualities are priceless fighting assets that "Lucite" provides for our airmen on these and many others of America's fighting planes. In turrets, nosepieces, cockpit enclosures, and windows, "Lucite" is helping our pilots and gunners to see straight, fly straight, shoot straight.

There are other advantages, too, in this widely used material. For example, consider the advantages of high tensile and flexural strength, light weight, resistance to many chemicals and excellent weathering qualities of "Lucite" methyl methacrylate resin.

In addition, the ease of machining "Lucite" and its ability to be heated and formed into large single-piece enclosures helps in other important ways: fewer structural supports and larger panels result in less overall weight and fewer blind spots. Faster production too. The one-piece canopy on the Mustang P-51, for instance, was manufactured at a saving of 45% in man-hours as compared with earlier methods of construction.

Yes, you'll see more and more "Lucite" on the battle planes of today, and on the peacetime planes to come.

"Lucite" is obtainable for war orders and in experimental quantities for test purposes. Write E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 South Broadway, Los Angeles, California. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

Buy and Hold WAR BONDS

DU PONT — BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

FOR *PLASTICS* . . CONSULT *DU PONT*

those airplanes undergoing conversion at that center.

A Central Control System has been developed at the Douglas plant which incorporates the use of master records containing information about all tools or parts that may have been manufactured by each center, making them available for use at one of the three other centers.

Douglas started its conversion work in mid-1944 when the first DC-3's originally taken over by the Army were returned to the air lines. As the volume of C-53's and DC-3's being returned to the operators increased, it became evident that the capacity of the parent plant to do the work was inadequate because of the demands of its military schedules. After converting 20 army transports to air liners at the Santa Monica Plant, the Douglas company discontinued this work and began organizing the system of qualified conversion centers throughout the United States and Canada. Douglas Aircraft Company, Inc.

Cowl-Flap Actuating Motor

Designed especially for cowl-flap actuation on the Douglas A-26 attack bomber, a compact mechanism combines an electric motor, gear reduction, and control unit to fit the mounting conditions and limited available space. The installation is designed to maintain proper engine temperatures under conditions varying from −70°F. to +140°F., and from sea level to the optimum altitude of the Army A-26.

The unit consists of a $^1/_6$-hp. motor, thermally protected and equipped with magnetic clutch and brake. Shaft output is 8 in.lbs. at 1,200 r.p.m. An 8 to 1 gear reduction is provided for opening and closing flaps, with double reduction and worm drive to operate cams limiting the travel of the flaps. As supplied for use in a 28-volt system, this motor-actuator complete weighs only $4^3/_4$ lbs. Electrical Engineering and Manufacturing Corporation, Los Angeles.

Parallel Generator Operation for Large Bomber Power Systems

Parallel operation of 400-cycle a.c. aircraft generators under conditions simulating combat emergencies has been demonstrated successfully to A.A.F. representatives at General Electric's Schenectady works. Developed at the request of the Army Air Forces for the electric power systems of large bombers, the parallel-operation principle is expected to contribute materially to their effectiveness.

Engineers responsible for the new parallel arrangement say that it will prevent any of the remotely controlled machine gun turrets from being knocked out of action because of failure of an engine. In effect, paralleling permits the plane's generators to come to the rescue of one another instantaneously and automatically. Thus, power supply to all of the electrically operated turrets is continuous even though part of the system is put out of commission.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

According to the engineers, parallel operation of the generators required the development of a new high-speed governor capable of holding frequency and dividing the power load equally among engines operating at different speeds. The new governor is described as an electromagnetically actuated pilot valve operating a hydraulic servo mechanism. The parallel-generator operation permits the use of an alternating-current system throughout the plane, minimizing the problems of commutation and brush wear at high altitudes.

In the demonstration of the parallel principle General Electric engineers used two 400-cycle, 30-kw., 40-kva. aircraft alternators. Each alternator was driven by a 450-hp. aircraft engine through Sundstrand variable-ratio drives governed to maintain synchronism and equal load division in spite of imposed variations in engine speed. A special air cap over the exciter end of each alternator provided cooling air for the ground test, substituting for rammed air. A gear-box arrangement was used to simulate the step-up gear for the accessory drive employed on an actual aircraft-engine installation. General Electric Company.

Fuse for Aircraft Electrical Systems

A current-limiting fuse developed for protection of aircraft electrical systems is based on a design similar to that of high-voltage power fuses developed for utility company and industrial service.

The new fuse meets the requirements of adequate interrupting capacity, short arcing time, resistance to vibration and shock, high-altitude and wide-range temperature operation, small size and light weight. Tests made in a pressure chamber simulating conditions at 40,000-ft. altitude have demonstrated that the new fuse will dependably interrupt more than 4,000 amp. at 120 volts, 400 cycles, single phase a.c., or at 120 volts d.c., with an arcing time of less than $^1/_4$ cycle on the a.c. circuit.

The new fuse uses a pure silver wire element because of its low specific resistance and high melting point. Supported by two molded end pieces in the center of a Pyrex glass tube, the silver wire element is surrounded by a special filler of granular quartz. Three such units comprise the fuse, providing a three-pole assembly with several advantages: the fuse units in all phases must be replaced simultaneously; there is no chance of one phase being left open accidentally; because the phases are in separate isolated compartments, phase-to-phase short circuits within the device are prevented during interruption.

The manufacturer states that the new fuse is suited for aircraft circuit protection because its current-carrying ability and time-current characteristics are similar to those of the conductors used and are not appreciably affected by differences in ambient temperature. General Electric Company.

Development of 400-Cycle Aircraft Motors

Five different kinds of engineering problems were involved in designing 400-cycle electric motors for aircraft, these being electrical, mechanical, thermal, airflow, and lubrication. High-speed operation, better material utilization, and varying conditions under which the motors operate were complicating factors. Correlation of these factors was difficult because any one might affect the others.

It was found that motors of the open type are most satisfactory for the majority of aircraft applications because they do not possess explosion-producing characteristics and can be ventilated with less complication and without excessive weight increases. Gasoline-pump motors require an explosion-resisting construction. Some of these operate submerged, with vital parts directly exposed to the gasoline. A few totally enclosed intermittent motors may be required for engine-nacelle or other locations saturated with oils or dirt.

A 4-pole motor with a synchronous speed of 12,000 r.p.m. is used in most applications. However, speeds of 24,000, 8,000, 6,000, 4,800, and 4,000 r.p.m. are also possible from 2, 6, 8, 10, and 12-pole windings respectively. Generally a lighter weight power unit can be obtained by gearing down to the desired speed rather than increasing the number of poles. Six- and 8-pole motors have a limited use for driving loads such as centrifugal fans and gasoline pumps because of the noise and lubrication problems associated with gears. Lighter weight motors could be obtained by using 2-pole windings if there were suitable bearings capable of withstanding speeds approaching 24,000 r.p.m. without freezing at low temperatures.

At present only ball bearings are employed for the high-speed operation but sleeve bearings with special lubrication may be used in the future. Bearings of the minimum size necessary for radial and thrust loads and the specified life should be used to prevent excessive torque for overcoming friction at low temperatures. General Electric Company.

Selenium Rectifiers for Power Conversion On Aircraft

Progress is reported in the development of selenium power rectifiers for converting alternating to direct current

This happens to the best galvanized sheets...

Galvanized sheet steel is an excellent metal for many purposes, but there is one thing it won't do. It won't take and hold paint satisfactorily. The photo tells the story. The raw zinc surface dried out the essential oils in the paint, caused it to become brittle. Result: early paint failure.

This happens even when the zinc surface is acid-etched. Etching has other disadvantages, too. Besides being slow and costly, it destroys part of the protective zinc coating.

Paint on regular galvanized steel *isn't* satisfactory . . .

But this bonds paint to zinc

ARMCO Galvanized PAINTGRIP sheets are the answer to this old problem. They can be painted immediately. What's more, they give aircraft templates this *triple protection* . . .

1. The steel base has a *full-weight coating of zinc.*

2. The coating is given a special Bonderizing treatment at the Armco mills.

3. This "insulated" surface grips the attractive paint finish in a lasting bond — prevents it from drying out quickly and peeling and flaking.

For a smooth and durable paint finish on your templates ARMCO Galvanized PAINTGRIP sheets are the logical choice. Write for the free PAINTGRIP booklet. It gives complete information. Just address The American Rolling Mill Company, 1831 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

The "Scratch Test" shows how paint sticks to ARMCO Galvanized PAINTGRIP steel. The top half of the sample is mill-Bonderized. When scratched with a penknife only a slight mark can be seen. Paint on ordinary galvanized (bottom half) scrapes off readily.

The American Rolling Mill Company

SPECIAL-PURPOSE SHEET STEELS

GALVANIZED PAINTGRIP ARMCO STEEL

on large aircraft. Indicating that many of the large planes of the future will have auxiliary power generated as a.c. but that considerable amounts of d.c. power will still be required, it is stated that the selenium rectifier will have a wide field of application.

It is stated to have several advantages as a means of conversion. It does not have the high voltage drop of an electronic tube nor the moving parts and brushes of a rotating machine; it is simple, reliable, and easy to maintain; for three-phase power input it can be designed for 85 per cent efficiency; the weight of a complete unit, including transformer and voltage-regulating equipment, compares favorably with that of a motor-generator set of the same rating.

According to the manufacturer, selenium rectifiers can be used with transformers to obtain any desired output voltage. Input may be single phase or polyphase. The widest present application is for 28.5-volt d.c. units with three-phase input. For some applications where the d.c. load is substantially constant it may be practical to use selenium rectifiers without voltage regulation. Such rectifiers may be designed to operate directly from the a.c. line or with a suitable transformer to provide any desired d.c. voltage. Variations in d.c. voltage will be only slightly greater than those of the system a.c. voltage. General Electric Company.

Ignition Transformers for Aircraft

Three new 115-volt, 400-cycle ignition transformers are designed to provide a high voltage arc for igniting fuel in gasoline-fired aircraft cabin heaters and deicers. The units are shielded and filtered to minimize radio interference over all wave bands from 110 kilocycles to 200 megacycles.

Two of the transformers, with an output capacity of 6,000 volts each, are of the single-secondary type. The third has a double secondary, rated 6,000/-6,000 volts, for heaters with dual ignition or for two separate heaters with single-ignition systems.

The units are housed in plated-steel cases and all coils are imbedded in a specially developed high-melting point, moisture-resistant insulating compound. They will withstand the vigorous service required of all aircraft equipment and will operate over a wide range of ambient temperatures from −70° to 140°F., at altitudes from sea level to 45,000 ft. General Electric Company.

Hermetic Seal for Electric Instruments

A method has been developed for hermetically sealing electric instruments against humidity, water, dust, fungus, discoloration and other adverse conditions. To obtain a hermetically sealed enclosure, a thick, special, strain-free glass window is fused to a metal ring in a glass-to-metal seal. This assembly is then fused to a steel case by a solder joint. Hermetic sealing of the two terminal studs is obtained by glass-to-metal seals between each metal stud and the metal eyelet. This hermetic assembly is sealed to the steel base by a silver-solder operation.

The metal base is secured to the case by means of a synthetic-rubber gasket that is coated with a special sealing compound. The seal is obtained by a crimped-over metal ring, which compresses and retains the gasket. The glass seal, the soldered joints, and the metal ring form a completely hermetic enclosure for the instrument. According to laboratory tests, this means of sealing is unaffected by thermal shock, mechanical shock, or fatigue vibration.

The final assembly is evacuated, filled with an inert gas through a seal-off tube located in the base, and is sealed off at a pressure slightly above atmospheric. In an emergency where it might be necessary to get inside the instrument to make repairs or adjustments, a metal tab can be pulled, which will break the metal ring sealing the back. To reseal, a new metal ring can be installed, restoring the instrument to its former condition with the exception of the inert gas which in no way affects its operation.

The sealed-in process is now being used primarily on smaller instruments but experiments have been undertaken to develop a means of hermetically sealing larger equipment as well. General Electric Company.

Track Roller for Cowl and Flap Doors

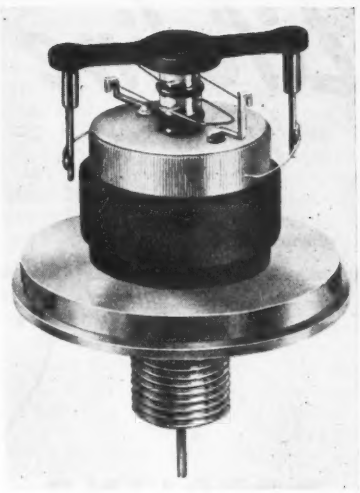
A universal ball-swivel track roller is intended to provide an almost frictionless connection between movable members and the tracks, to give smooth operation despite weaving of the member or waviness in the track. By the elimination of binding and jamming troubles, ease of motion is provided in sliding cabin enclosures, cowl and flap doors, and other sliding members.

These track rollers are made with $^1/_4$-in. diameter, and are available in two different shaft lengths, $^3/_8$ in. and $^{13}/_{16}$ in. The roller is also made to specifications to meet individual requirements. A lightweight heat-treated alloy steel is used and all parts are plated to prevent corrosion. General Engineering and Manufacturing Corporation, Newark, N.J.

Autoflight High-Sensitivity Resistors

Autoflight high-sensitivity resistors have been designed with overall dimensions of $1^1/_4$-in. by $1^1/_{16}$-in. diameter. These small-size resistors produce a variable electric resistance from a low-torque rotational movement. They can be connected directly to sensitive low-torque apparatus, such as aircraft flight-test recording instruments, and will operate relays or recording systems without the use of amplifiers, and from a simple d.c. source. These high-sensitivity resistors are particularly useful in laboratory or industrial applications where photoelectric cells and amplifiers were heretofore required.

Obtainable in various types from 100 to 1,500 ohms, and from 4 to 15 watts,



The Autoflight high-sensitivity resistor designed and manufactured by G. M. Giannini & Co., Inc., has overall dimensions of $1^1/_4$ by $1^1/_{16}$ in. diameter.

Autoflight resistors require but 2 gm. mm. input torque to overcome friction. This low value is secured by use of a jewel-supported shaft, the contact mechanism being made with the accuracy of a fine watch. G. M. Giannini & Company, Inc., Pasadena, Calif.

Precision Toroidal Coil Winder

In connection with the manufacture of remote indicating compasses for aircraft, Autoflight aircraft-instrument engineers were confronted with the problem of winding toroidal coils of $^1/_2$-in. diameter. This is stated by the makers to be the smallest coil of its kind ever attempted in the United States. The engineers designed and built a diminutive machine to wind the coils, the machine being so small that its operation is controlled by the use of a microscope. G. M. Giannini & Company, Inc., Pasadena, Calif.

Splined Rivnut

A new Rivnut of the splined type, suitable for use in wood, plastics, leather, hard rubber, or other material where it is necessary to anchor a nut firmly for attaching accessories, is offered in addition to the regular line of Rivnuts.

In the new type, splines beneath the countersunk head supply resistance to torque, while the bulge or "upset" which forms below the end of the splines furnishes the tension resistance. The splined nut is thus locked into place two ways. Internal threads left intact within the shank take an attachment screw for installation of accessories.

The splined nut can be installed with the same type of tools regularly used for heading conventional types of Rivnuts in metal. These must be adjusted, however, to accommodate the longer shank of the splined type. Like other types, it is being made in three regular sizes, $^6/_{32}$, $^8/_{32}$, and $^{10}/_{32}$-in., in aluminum or brass. The B. F. Goodrich Company.

Lifeline of a Cargo Glider

ROEBLING AIRCORD

Again Proves Itself—as the Vital Link in "Air Pick-Up"

"Snatching" a loaded glider off the ground . . . and keeping it in tow aloft . . . puts a heavy strain on the connecting cable —that *vital* link.

That's why All American Aviation consulted Roebling in extending its remarkable, 6-year-old "Air Pick-Up" to cargo gliders. Result: the reel mechanism—heart of the system—now utilizes 1070 feet of 7 x 19, $\frac{3}{8}$" Roebling Aircord in conjunction with a length of nylon cord for elasticity . . . in a dramatic example of "Control in the air."

"Air Pick-Up" is playing a part on remote battlefronts . . . transporting troops and heavy supplies . . . evacuating casualties. With peace, it may help reduce air freight costs . . . on short-haul routes or feeder lines.

Roebling Aircord's important role in "Air Pick-Up" is another example of the reliance placed by aircraft engineers on Roebling wire and wire products. You, too, can rely on Roebling . . . as your source of supply—for Control Cord and Strand, Terminals, Complete Swaged Assemblies, Control Casing, Special Wires and Cables, and Slings.

Aircord Division

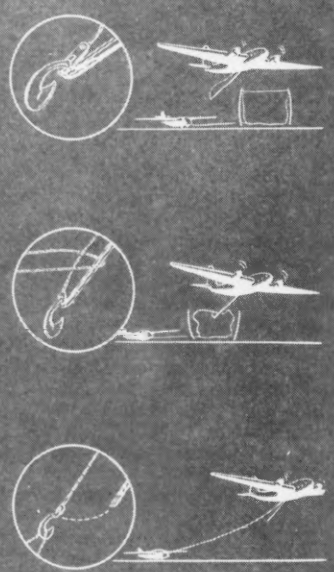
JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY

Branches and Warehouses in Principal Cities

GLIDER PICK-UP:

How it Operates



ROEBLING

means Control in the air

CONTROL CORD • STRAND • CONTROL CASING • SLINGS

TERMINALS • COMPLETE SWAGED ASSEMBLIES • SPECIAL WIRES AND CABLES • WIRE ROPE • ELECTRICAL WIRES AND CABLES • WIRE CLOTH AND NETTING

Open-End V-Belting

An "A" section has been added to the line of open-end V-beltings. Used where endless V-belts do not meet requirements, open-end V-belting is now available in four standard sections of the same cross-sectional dimensions as endless V-belts, allowing use of standard sheaves.

These sizes are the "A" with $^{17}/_{32}$-in. top width and $^{5}/_{16}$-in. thickness; "B" with $^{21}/_{32}$-in. top width and $^{7}/_{16}$-in. thickness; "C" with $^{7}/_{8}$-in. top width and $^{5}/_{8}$-in. thickness; and "D" with $1^{1}/_{4}$-in. top width and $^{3}/_{4}$-in. thickness.

Extension of the application of open-end V-belting has been made possible by development of a new fastener named "Flex V" by the Flexible Steel Lacing Company. This fastener can also be used on "B" section open-end V-belting, and is simple, inexpensive, and easily applied.

Speeds of below 3,000 ft. per min. are recommended for most efficient operation of open-end V-belting. The minimum recommended pulley diameters for the "A" section are 3 in., "B" section, 5.4 in., "C" section, 9 in., and "D" section, 13 in. The B. F. Goodrich Company.

Lighter Mounts for Superfortress Engines

A new engine mount for B-29 Superfortresses is reported to provide a weight saving of approximately 36 lbs. per airplane and to add more than 100 lbs. to the bomb- and fuel-carrying capacity of each B-29. The saving per mount over current types of B-29 engine mounts is stated to be almost $1^{1}/_{2}$ lbs., with each of the B-29's four engines requiring six mounts.

An adaptation of an improved mount announced previously for B-17 Flying Fortresses, this design features a cylindric cushion of rubber which operates in conjunction with a self-lubricated ball joint. The combination results in the control of vibratory forces in all directions, providing better aiming of guns and bombsights. Serviceability of the Superfortress is also extended by eliminating as much as possible the vibration from each plane's four engines. The Goodyear Tire & Rubber Company.

Cable and Wire Stripper

Wire or cable up to $^{5}/_{8}$-in. diameter can be stripped of its rubber, asbestos, synthetic, plastic, glass, cambric, or other insulation by a new wire stripper. Either single or parallel conductor can be stripped. Plain or grooved blades are used depending upon the type of wire.

Parallel wire, heater cord, inner conductors, and other types of electric cord can be stripped with plain blades. The grooved blades are intended for rubber covered and weatherproof cable, and are available in 15 standard sizes.

To use the stripper the operator lays the wire in position between the jaws and cutting blades and pulls the handle. This causes the gripping jaws to grasp the wire and draw it through the oscillating blades. The pulling action is in a straight line, tending to eliminate scraping and nicking of the wire.

The jaws automatically center and grip any diameter of wire without manual adjustment and instantly release the wire at the end of the stripping stroke. Blades open automatically to receive the wire when the lever is pushed forward. An adjustable stop provides for varying the length of stripping or it can be removed when extra long stripping is desired. Ideal Commutator Dresser Company, Sycamore, Ill.

Electro Starter for Aircraft Engines

An electro starter is being used for the testing and starting of B-29 engines. This is a three-wheeled, rubber-tired unit weighing about 1,200 lbs., which can be pulled manually or towed by a small tractor. Brakes are supplied on the full-swivel front wheel to lock the unit in place, preventing creeping while in operation. The motor has input of 440 volts, three-phase, 60 cycle, a.c. The generator output capacity is 24–28 volts, 400–600 amp. d.c., designed especially to meet the requirements of aircraft-engine starting and accessory testing. The control panel is provided with push-button starter, rheostat for manual operation, and switch for automatic voltage regulator operation. The switch panel has two disconnect switches providing two separate circuits so that two airplanes can be serviced at the same time. The motor and generator are mounted on a fabricated steel base and the housing is made of heavy gage sheet-metal, water-tight construction.

This new electro starter eliminates the use of batteries for starting and is credited with being a more efficient method. Kurz and Root Company, Appleton, Wis.

High-Frequency Ignition System

Information has been released about a newly perfected high-frequency, low-voltage ignition system designed to fire spark plugs even when the plugs are extremely fouled or dirty. The manufacturer calls attention to the ability of the high-frequency system to fire a spark plug that has become fouled, leaded, or carbonized when engine speed is reduced during the landing glide, and to its reliability at altitudes of 50,000 ft. and above where the spark in conventional systems tends to get out of control. Other advantages mentioned are greater engine output, longer spark-plug life, reduction in radio interference, and weight reduction. The system was developed by the company in cooperation with the Army Air Forces.

It incorporates high frequency at the spark-plug electrodes and low voltage generation and distribution to the spark plugs. Low voltage (approximately 1,200 volts) is generated in a magneto and distributed through shielded leads to the spark plug. At the manifold ring, the low-frequency energy of the magneto is converted to high-frequency or radio frequency energy (2,000,000 to 3,000,000 cycles per sec.) by an impulse-type frequency converter. At the spark plug, the low-tension, high-frequency energy is stepped up to a voltage of approximately 10,000 volts by means of a small transformer hermetically sealed in the well of a standard aircraft spark plug.

Five of these high-frequency systems now are undergoing service flight tests at the army base at Smyrna, Tenn., using four Liberator bombers. The company is cooperating with other manufacturers in the aircraft and automotive ignition field by granting licenses and manufacturing rights wherever such action will help the war effort. P. R. Mallory & Company, Inc., Indianapolis.

New Method for Locating Electronic Cables

A simple solution to the old problem of installing and accurately positioning interconnecting cables for electronic equipment has proved particularly valuable for facilitating critical cable assemblies and installations.

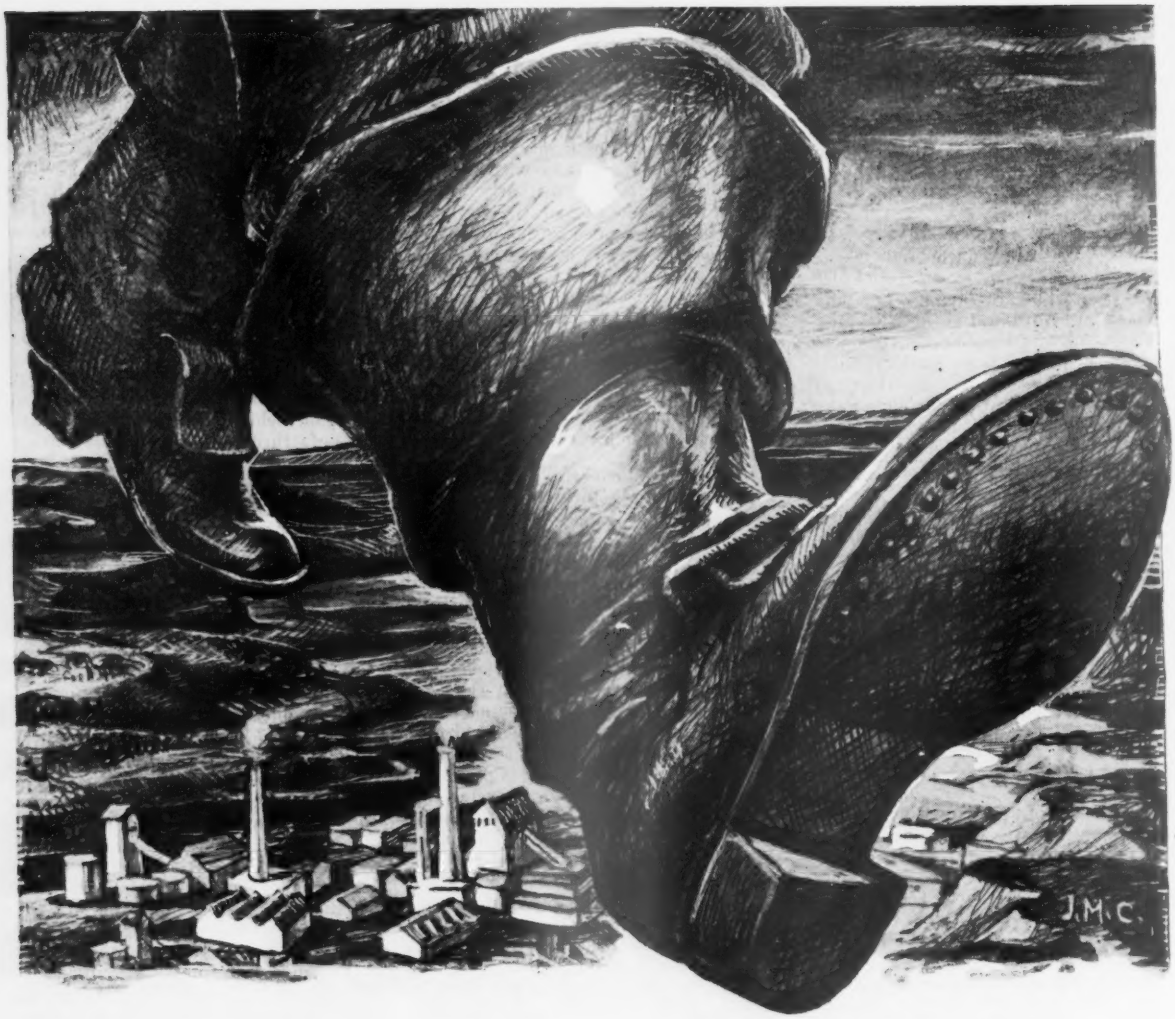
The solution to the problem was obtained by merely painting two indicating marks on each cable. These locate the cable with respect to the nearest structural clamp, thereby accurately determining the location of the connector in the plane. The method also establishes the orientation of the right-angle connectors, which eliminates twisting and possible breaking of wires when the cable is later connected to the equipment.

The indicating marks are applied to the cables by means of a special jig prior to the installation of any wires. One of the most important features is that wire flow is established once and for all at the assembly point. With this method, the operator always knows definitely which way the wires are to flow, even before the plug is attached. Prior to the adoption of the indicating system the operator did not have this information and as a result many wires were kinked or otherwise damaged within the cable. The Glenn L. Martin Company.

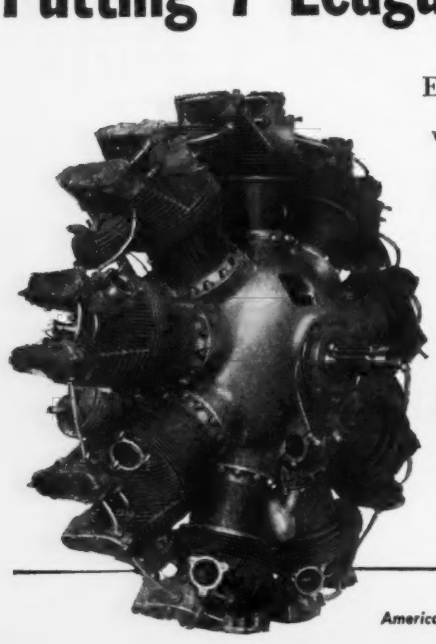
Cable Clamp

A quick-acting, all-purpose cable clamp makes possible the accurate measurement of any cable's load. With this patented device, damage at the crimped point and a consequent false breaking point are avoided.

Suggested by the old seafaring trick of looping a rope around a capstan, the new invention features a dual pulley whose diameter is such that tension on the cable is relieved and the clamp bears only a small part of the strain. An additional feature is an automatic locking bolt comprising a scissor mechanism consisting of two cross slots so arranged that the pull of the cable urges the locking bolts into a firm clamping



Putting 7 League Boots on an Airplane...



Extra Range—Extra miles per pound of fuel and engine weight—that's diesel power! The new, light-weight, higher horsepower, radial air-cooled Guiberson Diesel is coming. And with it will come longer range, lower operating cost and greater safety in aircraft power plants.

Guiberson U.S.A. DALLAS, TEXAS

ESTABLISHED 1919

THE GUIBERSON CORPORATION GUIBERSON DIESEL ENGINE CO.

Producers of Aircraft Diesels, Aircraft Parts, Oil Tools and Oil Heating Units

America's Radial Air-Cooled DIESEL *Engine*

By using corrugated steel scrap strips to hold small parts during painting operations, The Glenn L. Martin Company has facilitated such operations and saved time and expense.

position at the ends of the cable. The self-locking bolt replaces twelve hand-adjusted bolts found in previous types of cable clamps.

A recent demonstration of the new-type clamp showed that only 2 or 3 min. were needed to adjust a cable for test purposes, an operation formerly requiring up to $^1/_2$ hour. The clamp was attached to an Amsler testing machine and steel cable of the same type used for control cables on the PBM-Mariner was inserted. Failure occurred precisely in the center of the cable, at a load point several hundred pounds above specification. Designed originally for $^1/_{16}$- to $^1/_4$-in. cables, the clamp can be adapted to accommodate any size cable and to fit any type of machine. The Glenn L. Martin Company.

Corrugated Strips for Holding Small Parts

Corrugated steel scrap strips are being used in various widths and corrugation dimensions to hold small parts while they are being painted in the automatic conveyer sprayers and on the hand sprayer racks. Making the strips available in many sizes is said to prevent even the smallest of parts from being blown out of line by the force of the spray, as was the case when fine-mesh screen racks were used. The new method is also credited with being more satisfactory than the gummed-tape system because it holds parts with curved surfaces more securely than does the tape. Considerable timesaving in moving the parts to the drying racks, the fact that the strips can be used for many operations before cleaning becomes necessary, and the elimination of the cost of gummed tape are all advantages claimed for the innovation. The Glenn L. Martin Company.

Diminutive Vibration Detectors

Several hundred small vibration detectors, known as accelerometers, each weighing less than 2 oz., have just been completed for the armed services and for private aircraft companies, to be used during ground and flight tests in conjunction with electrical amplifying and recording units. A one-man production department turns out these accelerometers. An ex-watchmaker shapes each of the 72 minute parts from iron, aluminum, and copper alloys. The delicate pieces must be solidly mounted, made sensitive to the slightest tremor yet shock-resistant. The finished product has enabled airplane builders to solve the old problems of wing flutter.

Use of this miniature instrument in recent years has led to major changes in design criteria and military aircraft specifications, notably on tails, nosegears, and fins. The same apparatus has also made it possible to measure gunfiring reaction loads on airplanes, as well as the closely spaced time sequences in aircraft bombing systems. Development work is under way on a still smaller vibration detector, a $^1/_2$-oz. unit to be used in wind-tunnel tests. The Glenn L. Martin Company.

Power Supply for Test Line

Installation of a collector-type power-supply system for aircraft-turret test and assembly lines where electrical connections are required solved a problem that arose when the length of the turret-testing lines was extended from 25 to 150 ft. On the short line the necessary connections had been made by plugging the individual turret cables into an overhead bus. To continue this practice would have made it necessary to provide long cables along practically the entire length of the extended line. This presented a hazardous condition because turret fixtures might cut the cables and cause short circuits, and testers working along the line would be subject to a foot danger because of cables spread over the floor.

The chief problem encountered in devising the new system was the design of trolleys that would provide positive contact at all times, whose location would not hinder the turret-assembly work, and would not be exposed to damage. The design also had to provide means of mounting the trolley on the turret fixture and eliminate the need for a track that would run completely around the conveyer system. Since the current demand of each turret is extremely high at the start, compared to normal operation, special contacts and bus bars were provided. The power supply for the new system is a 500-amp. generator with batteries "floating" on the line to compensate for large current demands when the turrets are started.

A feature is the automatic "make" and "break" setup. Since the conveyer continually moves at slow speed, it is necessary that the contacts make positive connection with the bus at both the entrance and exit of the line. This prevents burning of contacts in case of the current being drawn at either end. The "make" and "break" is accomplished by means of a cam at the entrance and a solenoid operated by a microswitch at the exit.

By using the new installation it has been possible practically to eliminate the amount of maintenance time formerly required to repair cables and connections. Another production-timesaving results since it is not necessary for testers to walk from one end of the line to the other to get the necessary power supply cables, as was the case with the overhead power line. The Glenn L. Martin Company.

Electronic Control Stick

An electronic control stick, developed by the Air Technical Service Command and the Minneapolis-Honeywell Regulator Company, was designed for use on heavy four-engined bombers including the B-29 Superfortress, and first installed on Consolidated Liberators.

Called a Formation Stick, the control is a pistol-gripped lever about 10 in. long, mounted with an arm rest beside the pilot. It is free to move in all directions in exactly the same manner as the control stick of pursuit aircraft. Through electronic amplification and the servo motors of the control surfaces, the stick controls the airplane, resulting in diminished pilot fatigue on long flights, especially when tight formations must be maintained.

Ordinarily, in turbulent air, with planes flying close together, both the pilot and copilot, each exerting his full strength, were required to hold their plane on a steady course and retain a fixed position within the formation. In turns the task becomes very difficult and airplanes may become separated from the flight and fall prey to waiting enemy pursuit craft. To relieve this strain, engineers undertook to develop a device that would take over all of the effort required in formation flying and substitute the servo motors of the autopilot for the muscles of the airmen. The autopilot itself is the electronic flight-control system developed by Minneapolis-Honeywell and used on the Army's heavy bombers. The servo motors move the control surfaces

THERE ARE NO SIDETRACKS IN THE SKY

Cargo by the ton flies straight to its destination in the "Packet," the Army Air Forces' cargo carrier designed by Fairchild and built by Fairchild and North American Aviation.

Into the spacious hold of Fairchild's "Packet" will go lethal loads of guns, tanks, paratroopers, ammunition and supplies—destination Japan.

It is nicknamed the "flying boxcar" because of its cargo capacity—2,312 cubic feet of space—and its ability to carry up to nine tons at speeds which are still restricted information. Its maximum range, with conservative loads, is approximately 3,500 miles.

Forty-two paratroopers with full equipment can be "delivered" through two rear jump doors, clear of any obstruction. An ingenious device sends equipment parachuting through special doors in the belly, simultaneously with the paratrooper's jump.

The "Packet" is loaded with extreme ease. The floor of the fuselage is parallel to the ground and at standard truck floor height. Two 2100-horsepower engines impel its flight on wings that span more than 106 feet. Its overall length is more than 75 feet and its height 26 feet.

With but minor changes, it will become an efficient and profitable carrier of cargo and passengers in peacetime, flying the main lines with never a wait on a siding.

All metal in construction, this flying boxcar possesses characteristics inherent in all Fairchild products, "the touch of tomorrow in the planes of today."

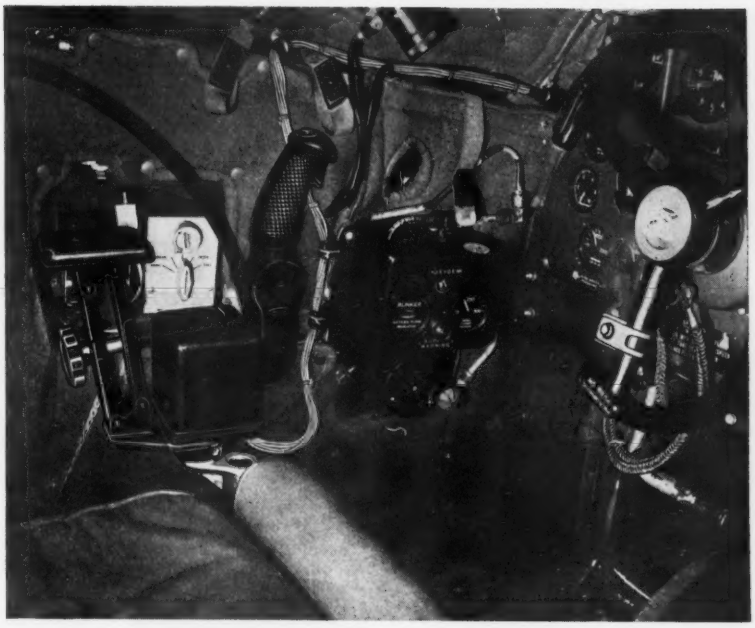
BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland

in exact proportion to the movement of the Formation Stick and the plane consequently alters course. A stabilizing mechanism has been added to give the stick "feel" which prevents the inadvertent application of abrupt control. Instead of exerting with both hands and feet a combined force of perhaps 100 lbs. to hold the bombers on course, pilots now are able to achieve the same result with one hand by moving the Formation Stick with a 1-lb. pull.

The new instrument not only greatly reduces pilot fatigue but also, through its ease of operation, simplifies the task of evasive action where, in order to avoid antiaircraft fire, pilots change flight direction frequently. In addition, the stick makes possible tighter formation flying, avoids "straggling" and permits an entire flight of aircraft, no matter how many in number, to turn as a unit with greater flying ease. Minneapolis-Honeywell Regulator Company.



Through electronic amplification and the servo motors of the control surfaces, this formation stick, developed by the Air Technical Service Command and Minneapolis-Honeywell Regulator Company, relieves pilot strain in flying.

Machine for Washing Industrial Parts

The Modern Mechanic is an automatic washer for industrial use. The heavy-duty model includes rinse vats for production-line work. One man can service three baskets of metal parts, washing, rinsing, and draining each basket at the same time.

The impeller pump is powered by a $^1/_2$-hp. single-phase motor and forces a stream of solvent over parts to be washed, quickly removing acid, grime, grease, etc. Only 65 gal. of washing liquid are used, and it is automatically screened by a baffle-and-grill device so that it can be used repeatedly. A settling tank is provided for dirt and chips.

The heavy-duty model shown is 63 in. long, 21 in. wide, and 36 in. high. The manufacturer also produces an all-purpose model for intermittent use. Modern Mechanic Company, Chicago.

Casting Sealants

Monsanto Chemical Company has developed and placed in production a new series of casting sealants, now used for impregnation of aluminum and magnesium airplane parts. Working under conditions of utmost urgency, research chemists perfected the new impregnants at a time when a shortage of tung oil threatened to impede production of an important segment of the aircraft industry. When the first sizable quantity of the synthetic sealant was ready for use, only 2 days' supply of the natural tung-oil product remained in one of the largest and most important airplane-engine factories.

The new sealants are reported to make a complete, three-dimensional permeation of aluminum and magnesium castings, filling the microscopic hollows that they contain without changing their appearance or affecting precision tolerances. After being impregnated, the castings are heat-treated to change the impregnant from a liquid to a rubbery solid form. The manufacturer has predicted that the new developments will eliminate the need to rely on tung oil for impregnation of castings. The new materials, it is said, provide greater sealing efficiency, greater ease of processing, and full resistance to conditions imposed in aircraft operation.

The series of sealants which survived both initial and final tests, and which are expected to be continued in production after the war, were identified as being of the Thalid X100 series. These are special adaptations of a family of polyester-type resins used in low-pressure lamination in the plastics industry. Monsanto Chemical Company.

Spot-Welding Tweezers

Besco spot-welding tweezers consist of a pair of insulated, forged, copper tweezers with plastic-covered, flexible, copper leads terminating in a pair of lugs which connect in place of regular welding electrodes. Developed originally to weld radio-tube wires of 0.003-in. outside diameter, the tweezers are intended for use in instrument work and other kinds of fine workmanship. Instead of carrying parts to be welded to the welding equipment, electrodes may be applied directly to the elements to be joined. They operate on from $^1/_2$- to 1-kva. power at 10 amp., and are used with a timer that cuts the current and times the length of the weld.

The copper jaws are held like any ordinary pair of tweezers. They are brought into contact with the parts to be welded; these are lightly but firmly brought together; the foot switch is pressed, current is applied, and the weld is made. The tweezers will unite copper parts, nickel, steel, tin, tin alloys, brass, Monel, zinc, bronze, or nickel to tungsten, and copper to nickel. The maker states that the tweezers may be handled by an operator with limited experience and may be used constantly with bare hands. As many as 4,000 welds per hour have been obtained. The points of the tweezers require touching up not more than once a day. The flexibility of the device permits its use in practically any position. Standard leads are 18 in. They can be furnished, however, with leads up to 36 in. New Jersey Jewelers' Supply, Newark, N.J.

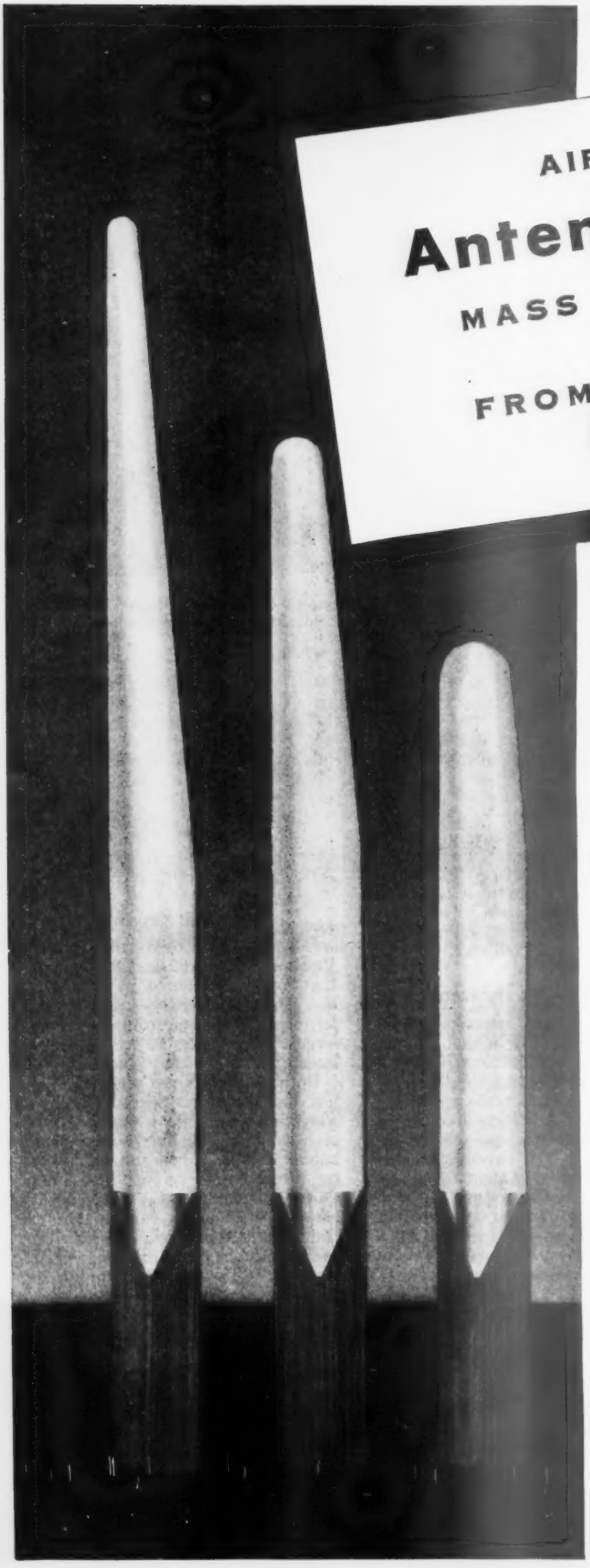
Electric Resistors

Two new series of Riteohm Precision Resistors—Series 82 and 83—are units that may be mounted by means of a through bolt. The Series 82 has two lug terminals at one end firmly fastened by screws. The Series 83 has radial wire leads.

Both new units are pie-wound to 1 per cent accuracy. Specially enameled alloy resistance wire is noninductively pie-wound on a nonhygroscopic ceramic bobbin that has a hole through the center for a No. 6 screw. After being wound, the units are vacuum-impregnated with a special varnish that provides additional insulation and thoroughly protects the winding against humidity. The resistors can be supplied with a varnish coating containing a fungicidal agent, thus making the units particularly suited for use in the tropics.

The Series 82 is available in three sizes—$^{11}/_{16}$-in. diameter by $1^1/_8$ in. long, $1^7/_{16}$ in. long, or 1 in. long, for the 2, 4, and 6-pie units, respectively. The minimum resistance is 0.1 ohm for all units and the maximum is 400,000 ohms for the 2-pie unit, 750,000 ohms for the 4-pie, and 1 megohm for the 6-pie unit.

The Series 83 is available in three sizes—$^1/_2$-in. diameter by $^7/_{16}$ in. long, $^5/_8$ in. long or 1 in. long. The first two



AIR CORPS

Antenna Stubs

MASS PRODUCED

FROM *Compreg*

These antenna stubs are made for the U. S. Army Signal Corps. They are manufactured on a mass production basis with standard wood and metal working machinery and tools. Because only one press and kiln operation is required, economical fabrication is possible. Haskelite's method of manufacture is flexible and, as a result, minor revision in size or design can be made at low cost by changing the machining operation only. Haskelite Compreg can be held to tolerances almost unheard of in the woodworking field. This material will lend itself readily to a wide range of applications. Following are a few of the characteristics of Compreg which may be revealed at the present time.

1. Density (both overall and sectional) can be controlled to plus or minus 5%.
2. When the part must be kept in dynamic balance, the center of gravity can be controlled.
3. Moisture absorption can be controlled to 4% at 1.2 S.G. and as low as 1% on greater densities. This characteristic assures low volumetric change.
4. Impregnation can be controlled to within plus or minus 1%.

Write for complete details

HASKELITE

MANUFACTURING CORPORATION

Better materials for the aircraft industry

Dept. A-3, GRAND RAPIDS 2, MICHIGAN

NEW YORK CHICAGO CLEVELAND

ST. LOUIS DETROIT

CANADA: Railway & Power Engineering Corp., Ltd.

units are 2-pie while the third is a 4-pie unit. The minimum resistance is 10 ohms for all units and the maximum is 200,000 ohms for the small 2-pie unit, 400,000 ohms for the large 2-pie, and 800,000 ohms for the 4-pie unit.

A few common applications for these resistors are voltmeter multipliers, laboratory equipment, radio and electrical test sets, attenuation pads, and electronic equipment requiring extremely accurate resistance components. Ohmite Manufacturing Company, Chicago.

Glass-Cloth Hangars for Airplanes

Glass cloth, woven of glass fiber yarns and coated with either synthetic rubber or resin, has been selected by the U.S. Army Corps of Engineers for curtains, side walls, and ends in newly developed airplane hangers installed at advanced Army Air Forces bases.

Two types of hangars incorporating the use of coated glass cloth have been designed. One is a large hangar 162 ft. long, 146 ft. wide, and 39 ft. high, which is capable of housing several planes. In this type of hangar, coated glass cloth is used as a curtain or door across the entire 146-ft. span.

Coated glass cloth is used for the side walls and end of a smaller hangar known as the nose or shed type. Corrugated steel is used for the opposite closed end. This type hangar is used primarily to house the forward part of planes. The fabric walls and end are of panel construction to allow the wing tips and tail of the plane to extend outside the hangar, giving protective covering to the most vital parts of a plane.

Glass cloth was selected because of its resistance to the effects of mold and fungus, high strength in proportion to its light weight, and ease of handling to fit around plane fuselages. Glass cloth is stated to have good weathering properties, and to be unaffected by tropical heat or arctic cold. Coatings used on the cloth include Neoprene and vinyl compound. Glass cloth is supplied by Owens-Corning Fiberglas Corporation, Toledo.

Cellophane Wrapping for Survival Equipment

Moistureproof cellophane is now used to wrap emergency lifesaving equipment carried on the Pan American Clippers. In addition to its resistance to moisture and its protection against deterioration, the cellophane enables life-raft inspectors to see what is inside each package without tearing it open, and to check the package at a glance. Since all equipment on the rafts is examined regularly to make sure that it will always be in perfect condition if needed, this saves a great deal of time on each inspection. Pan American Airways System.

Reverse-Current Relay to Withstand Vibration and Shock

Originally designed for special use on auxiliary engine-driven power generators in Army tanks and airplanes, the Type 9100 reverse-current relay is stated to be equally effective for any low-voltage d.c. application.

The design incorporates a magnetic latch that prevents accidental closing of armature and contacts caused by vibration or heavy shock. Contacts are rated 100 amp. at 30 volts d.c. maximum. Physical dimensions are width $4^1/_{16}$ in., depth $3^7/_{16}$ in., height $2^1/_{16}$ in. Approximate weight is 1.6 lbs.

The Type 9000 relay, without magnetic latch, is available in sizes as low as 300 watts at 6, 12, 18, and 24 volts d.c., for use where severe vibration and shock are not encountered. R-B-M Manufacturing Company, Division of Essex Wire Corporation, Logansport, Ind.

Automatic Magazine-Feed Screw Driver

The Screwmatic is an automatic screw driver operated by air or electric power, designed to drive screws in wood or metal. The easily detached self-filling magazine, which can be replaced in a matter of seconds, allows almost continuous operation with no hand feeding necessary. Each screw is driven to a predetermined depth as a gage on the spindle drive cuts off the torque; rotation of the blade is then stopped, protecting screw heads and the work surface against marring. It will drive all standard or special head screws, including slotted, Phillips, square, and octagonal types.

Filling of the magazine is accomplished by a semiautomatic filler. Screws feed automatically into the chutes which lead to the nine fill channels. When the lever is pressed, the magazine indexes and only four stops are necessary. One refill machine adequately services five Screwmatics. Reed-Prentice Corporation, Worcester, Mass.

Thunderbolt for Long-Range Operation

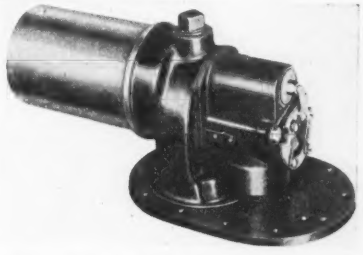
Carrying ten 5-in. high-velocity rockets and two 500-lb. bombs along with its eight 0.50-cal. machine guns, and with added internal fuel capacity that gives it a combat radius of more than 1,000 miles, a new version of the Republic P-47 Thunderbolt is designated as the P-47N. This new air weapon has a speed of more than 450 m.p.h. and weighs around 10 tons fully loaded. It is equipped with a new compensating gun sight.

Almost physically identical with the P-47D, the P-47N is distinguishable chiefly by its larger wing with squared tip. The installation of a dorsal fin extension improves the directional stability of the craft.

To attain the main goal of greatly increased range, engineers increased the internal gasoline supply by redesigning the wing section, increasing the span by 18 in. and adding 22 sq.ft. more area. They also added eight gas tanks, one at the leading edge of each wing, and three in each wing near the wheel well. This almost doubles the internal fuel capacity of the earlier model.

The P-47N is powered by a Pratt & Whitney R-2800-C series engine that provides additional horsepower for take-off. The plane also has a larger, more efficient turbosupercharger, the General Electric CH-5. Improved water-injection equipment adds a considerable lift in power for longer periods than was possible with the P-47D.

Because this more powerful longer-range Thunderbolt is still a single seater, giving to the pilot the added responsibility of navigator, bombardier, gunner, and radio operator, the engineers have introduced innovations to minimize pilot fatigue, and many of the controls have been made automatic. The new plane is also equipped with folding rudder pedals to afford additional leg room and an improved seat with arm rests. Republic Aviation Corporation.



Romec Pump Company's submerged water-injection pump.

Fully Submerged Water-Injection Pump

A fully submerged water-injection pump developed for use on all types of aircraft supplies water or water-alcohol mixtures to be vaporized in the combustion chamber. Special internal insulation as well as external contact insulation is intended to solve corrosion problems. The pump is designed for wide temperature ranges with provision for rapid heat dissipation to reduce the freezing hazard. The Model RD 8500A pump is provided with a supercharger connection. Romec Pump Company, Elyria, Ohio.

Nomogram Speeds Inspection of Aluminum Bars

A new nomogram, designed by engineers of the Ryan Aeronautical Company, saves 95 per cent of the computation time in checking test bars of post-aged aluminum.

Only a few rapid steps are necessary to determine whether the metal test bars come up to the Army and Navy specifications with respect to tensile strength: (1) the cross-sectional area of the test bar is determined by locating the width and thickness dimensions on the two scales marked "dimensions," laying a straightedge between these points, and reading the area from the middle scale where the straightedge intersects it; (2) locate this area figure on the first scale and plot the yield or ultimate load, obtained from a test on the tensile testing machine, on the second scale marked "load"; (3) lay a straightedge between these points and read the tensile strength in lbs. per sq.in.

Beloved Duck ...and KENYON

SAILORS love the sight of the Columbia Duck—it has flown the ocean from Arctic to the tropics, picking many a pilot from the wing of his downed plane, flying wounded men to base hospitals—saving lives in addition to bringing the mail to ships in action and the other thousand-and-one odd jobs for which it is built. It is sturdily built, too, with a steel hull—and it is, like its namesake, amphibious, at home on land or water.

KENYON—is proud to have supplied precision parts for the Columbia J2F6—a role completely in character, since Kenyon means *custom precision craftsmanship*. In this way:

CUSTOM—it is our pledge that Kenyon can and will "design, create and produce precision parts to meet any manufacturer's specific need, even if such a part has never been made before."

PRECISION—is the tradition at Kenyon. Our laboratories, our engineering staff, our equipment are geared to extreme close tolerance work—*whatever its character.*

CRAFTSMANSHIP—Kenyon's staff of skilled employees are accustomed to dealing in ten-thousandths of an inch—are guided by the unvarying rule of *"make it right."*

Call on Kenyon—

Remember when you are faced with a precision problem, now or in the peace to come, that you have at your disposal all the facilities, the creative and productive skills that are Kenyon. This ability *to do* and *to make* is implemented by the unbroken promise "to supply the manufacturer with the precision parts he needs *in quantity* and *on time.*"

KENYON
INSTRUMENT CO., INC.
Huntington Station, L. I. • New York
If it's Kenyon-Made . . . It's Precision-Built

Beloved Duck ...and KENYON

SAILORS love the sight of the Columbia Duck—it has flown the ocean from Arctic to the tropics, picking many a pilot from the wing of his downed plane, flying wounded men to base hospitals—saving lives in addition to bringing the mail to ships in action and the other thousand-and-one odd jobs for which it is built. It is sturdily built, too, with a steel hull—and it is, like its namesake, amphibious, at home on land or water.

KENYON—is proud to have supplied precision parts for the Columbia J2F6—a role completely in character, since Kenyon means *custom precision craftsmanship*. In this way:

CUSTOM—it is our pledge that Kenyon can and will "design, create and produce precision parts to meet any manufacturer's specific need, even if such a part has never been made before."

PRECISION—is the tradition at Kenyon. Our laboratories, our engineering staff, our equipment are geared to extreme close tolerance work—*whatever its character.*

CRAFTSMANSHIP—Kenyon's staff of skilled employees are accustomed to dealing in ten-thousandths of an inch—are guided by the unvarying rule of *"make it right."*

Call on Kenyon—

Remember when you are faced with a precision problem, now or in the peace to come, that you have at your disposal all the facilities, the creative and productive skills that are Kenyon. This ability *to do* and *to make* is implemented by the unbroken promise "to supply the manufacturer with the precision parts he needs *in quantity* and *on time.*"

KENYON
INSTRUMENT CO., INC.
Huntington Station, L. I. • New York
If it's Kenyon-Made . . . It's Precision-Built

from third scale where the straightedge intersects it. This figure is compared with the specification to determine the suitability of the sample.

This nomogram is designed for use with aluminum but may be extended for use with steels and other metals. It is reported to be as accurate as the slide-rule method and can be used by the majority of employees who do not know how to use a slide rule. Ryan Aeronautical Company.

Boring Tool and Tool Holder

A new-type boring and cutting tool holder for use with the Shearcutter boring and turning tools is made in five sizes to fit lathes and screw machines from 10-in. swing to 36-in. swing. Each tool holder is provided with three boring bars, one of which is arranged for turning. In the larger sizes two bars are arranged for turning as well as for tolerances and finish.

The circular boring and turning tool gives from 20 to 50 new cutting edges simply by rotating it to a new position on its holder until resharpening is necessary. Regrinding is a simple operation that seldom takes more than 1 min.

Shearcutter boring tool holders are shipped complete with three boring bars, six bits, three wrenches for the cutter-bit holding screws, and wrenches for the boring-bar holder. Shearcut Tool Company, South Bellingham, Wash.

Powered Crush-Dressing Device

An electrically powered crush-dressing device for forming the wheel on precision thread and form grinders is available in two styles, either of which can be applied to new Sheffield machines or to those now in use.

With Model A, the operator presses a button after the crusher roll has been manually lowered into contact with the grinding wheel, which is made to revolve at grinding speed. The coolant flow is directed over the crusher roll as it is power-fed into the wheel at a constant rate, until the feed-indicator dial on the crushing device shows that the desired depth of dressing has been reached. The operator releases pressure on the push button, stopping the wheel, crusher infeed, and flow of coolant. He then lifts the crusher out of wheel engagement and the grinding of the work continues.

Model B is semiautomatic and is distinguished from Model A in that the feed-indicator dial is preset for a desired depth of automatic infeed of the crusher roll. After removal of the wheel guard and lowering the crusher roll into contact with the wheel, the closing of an electric switch starts the crushing wheel, the cycle of coolant flow, and the feed of the crusher into the wheel. The automatic cycle continues until the desired depth of infeed is reached, at which point the coolant, infeed of crusher, and rotation of grinding wheel are automatically stopped. The operator then manually returns the crusher roll to upper position and continues with grinding of the work.

These power crushing devices are stated to have many advantages over manual crushing, including reduction of dressing time by 50 per cent, and increased life of the crusher roll because of the uniformity of crushing and smoothness of infeed. The Sheffield Corporation, Dayton, Ohio.

A New Chair of Aeronautics

New facilities for the training of aeronautical engineers will soon be available as the result of a gift of £60,000 made by the Bristol Aeroplane Company to Bristol University. The money will be used to set up "The Sir George White Chair of Aeronautics" in memory of the founder of the Bristol company.

The new department at the Bristol University will be an integral part of the wider university community, and by maintaining a high degree of scholarship and research in close association with the technical and other resources of the Bristol company, it is expected to be in a position to offer first-class training to intending entrants into the aircraft industry.

It will also be a valuable addition to the facilities for advanced training in aeronautical engineering which will be provided by other universities in Great Britain and by the new College of Aeronautics to be set up in response to the recommendations of a Government Interdepartmental Committee that made its report last November. The Society of British Aircraft Constructors Ltd.

Plug Gage Having Chamfered Sections

The head of the new DuBo plug gage is a relatively thin disc that is a section of a sphere. The spherical gaging surface makes contact with the bore walls only at the instant and point of bore gaging. Two chamfered sections, diametrically opposed on each member, make it possible, by slightly tilting the handle, to enter the gage into bores easily, without force, or running the risk of marring even highly polished workpieces. The maker states that the gage can be used to check deep bores, as the handle need be tilted only slightly when applying the gage and does not touch the bore walls. The design of the gaging members also permits accurate gaging almost to the bottom of blind bores. The chamfered section makes possible easy inspection of deep blind bores. The chamfer edge serves an additional function in tending to wipe away foreign material from the gaging area and thus helps to prepare a clean surface for accurate gaging.

In use, only a small portion of the gaging surface makes contact with the surface of the bore walls. This materially reduces wear on the gage and also focuses the gaging contact to a small area. As the gage may be introduced into bores smaller than its diameter, it provides a means for checking out-of-roundness and taper, even when these conditions are on the minimum side of the tolerance or smaller than the Go dimension. It is consequently possible to check a back taper in a part that the ordinary fixed-limit gage could not enter, and to discover faults that conventional plug gages might bridge.

The small sizes, from 0.240- to 1.510-in. diameter, have the Go and Not Go gaging members attached to the opposite ends of a lightweight metal handle. The larger sizes, from 1.510-in. to 6.010-in. diameter, are single-end gages, individually mounted on palm-fitting plastic handles. Both types utilize a new color-identification system that eliminates wasted motion and the risk of errors in choosing the proper gage. The Go member of either the double- or single-end gage is marked with a broad band of vivid green enamel under a durable, transparent plastic ring. Not Go members are similarly identified by brilliant red bands. The handles of the double-end gages also carry corresponding dots of color. The correct gage head therefore may be immediately and unmistakably recognized regardless of the position in which the gage may rest on the bench or in the hand.

The thickness of both members of a double-end DuBo is the same, giving an even balance that adds to ease of handling. Gage members are of highly lapped, special alloy steel. As the actual contact between the spherical surfaces of the gage heads and the bore is very light and friction-free, wear is stated to be negligible. Standard Gage Company, Inc., Poughkeepsie, N.Y.

Surface Gages

Surf-Chek Roughness Standards have been developed by J. A. Broadston of North American Aviation, Inc., to meet the demand for uniformity in surface control. The kit contains a 65-page educational text bound to a gage consisting of 20 replicas of machined surfaces, prepared by turning, grinding, milling, honing, lapping, and polishing, which vary in roughness from 500 to 5 micro-in. The replicas are molded into a 5- by 7-in. plastic plate through the use of precise die inserts.

The new method of designation is intended to eliminate guess interpretation, to convey the engineer's specific instructions to the machinist, and to enable any one to make rapid and efficient roughness comparisons, without the need of other special instruments. Surface Checking Gage Company, Hollywood, Calif.

Improved Wiring for Gun-Mounted Microphones

A method of wiring gun-mounted microphone switches on Army B-17 bombers prepared for war duty at United Air Lines' Cheyenne modification center resulted in the saving of an estimated 21,600 man-hours a year during the height of the aerial warfare in Europe. In addition to man-hours saved in delivering bombers to fighting

Grumman Hellcat

Martin Mars

NO STRANGER TO THE AIR LANES!

Republic P-47 Thunderbolt

Chance Vought F4U-1D Corsair

Lockheed Constellation

Lockheed P-38 Lightning

Boeing B-17G Flying Fortress

Martin B-26 Marauders

Consolidated Vultee PBY Catalina

Bell-built Boeing B-29 Superfortress

PITTSBURGH Aircraft Finishes accompany these famous bombers, fighters and cargo carriers through the skyways of the world. There is no greater evidence of the stamina, long life and protective qualities of Pittsburgh's "fighting finishes" than their unsurpassed performance under conditions in which such aircraft have to operate. There is no better proof that aircraft manufacturers can *continue* to look to Pittsburgh for finishes with a "plus" over specifications!

Pittsburgh Aircraft Finishes include Camouflage Finishes . . . Protective Coatings for Wood and Fabric Surfaces . . . Zinc Chromate Primers for Metal . . . Lacquers, Clear and Pigmented . . . Dopes, Clear and Pigmented . . . Sealers and Surfacers for Wood . . . Plywood Finishes . . . Paints . . . Spar Varnishes . . . Heat-Resisting Enamels . . . Slushing and Sealing Compounds for Fuel Tanks . . . Caulking and Glazing Compounds . . . Chromseal Ribbon Compound . . . Fabseal Impregnated Tape . . . Chromseal Tape . . . Stratoseal Cabin-Sealing Tapes . . . Army and Navy Specification Finishes . . . Commercial Finishes for Post-War.

Call on us for enlightening facts and figures. Our extensive experience in the field of aircraft finishes often can save you time and money.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

PPG PITTSBURGH *Industrial* FINISHES

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

fronts, the wiring system resulted in saving vital materials such as rubber-covered wire cord and junction boxes, and was credited with decreasing wiring errors.

The method was devised after members of a bomber crew complained that use of their intercommunicating microphones had necessitated removal of one hand from the gun controls in order to push the switch button on the microphone, which sometimes diverted attention during critical moments of an air battle. The complaint was quickly remedied by rebuilding the microphone-control switch, placing it on the machine-gun grip so that the gunner merely had to slip his thumb to the side of the gun-grip to switch on his microphone.

Previously, the interphone communications unit for B-17 gunners required a separate junction box for each of the five sets and included intricate wiring and component parts. Approximately 40 min. were required to strip down and prepare the junction box for wiring revisions. In the new wiring system the jack box and all its component parts were eliminated. A microphone switch was mounted on the gun adapter and wiring was run directly to the plane's interphone jack box, saving approximately 40 ft. of electric cord.

For developing and perfecting the system, the inventor received $500 in War Stamps and Bonds from the company's employees' suggestion conference. He has also received a War Production Board honorable mention. United Air Lines, Inc.

Aeronautical Uses of Gas Turbines

At a meeting in New York on May 2, "The Place of the Gas Turbine in Aviation" was discussed by Charles D. Flagle and Frank W. Godsey, Jr., of the Westinghouse Electric Corporation. The opinion was expressed that the reciprocating engine, the jet-propulsion engine, and the gas turbine-propeller drive combination will each have a place in the future of aviation and that under certain conditions both of the turbine types offer advantages over the conventional reciprocating engine and propeller combination. Of the three types of power plant it is noted that the gas turbine-propeller engine has characteristics that give it advantages in all speed ranges and make it superior to the jet engine for low and intermediate speeds, while the jet engine is stated to be preeminent in the highest-speed range. The writers of the paper have reached their conclusions by comparing the performances of airplanes in which each of the three types of engines might be installed.

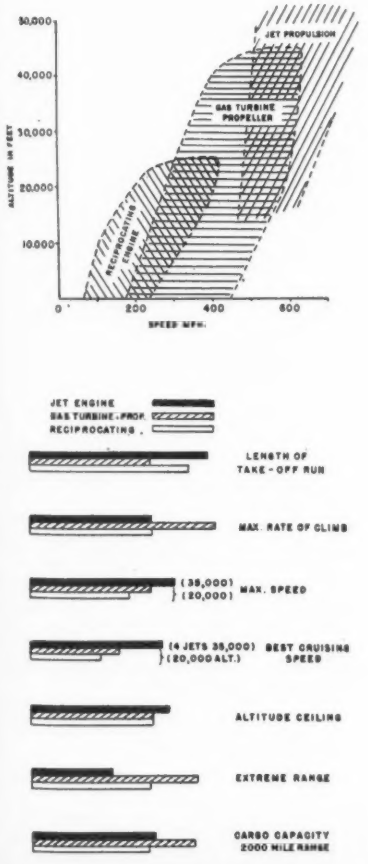
The paper gives lengthy consideration to the characteristics of the present-day reciprocating engine and the auxiliary equipment for cooling, controls, and disposition of exhaust gases. The operation of the gas turbine is then explained in detail, leading to a description of what is known as the true axial-flow jet engine, in which the full thrust is obtained by the reaction of the forces generated by heated and compressed gases, passing through a jet or nozzle. The advantages of the jet engine and its limitations are discussed in full.

The third type of power unit is the gas turbine-propeller drive of which the construction, efficiency, and application are thoroughly reviewed.

Tables give comparative data with respect to weight, take-off thrust, cruising speeds, fuel consumption, and range, while numerous curves and other charts give visual demonstrations of the relative performance possibilities of the three types of power plant. Westinghouse Electric Corporation.

15,000-Volt Thyratron Power-Control Tube

A new 15,000-volt Thyratron power-control tube provides split-cycle control of high power for radio-frequency heating units and radio transmitters. For electronic equipment designers, the Thyratron WL-678 makes possible smooth and instantaneous power control from 0 per cent to 100 per cent load; simplified automatic load control; high-speed automatic overload protection; low space and weight requirements and low control power requirements. The new grid-controlled mercury vapor rectifier tube is designed to combine the high voltage characteristics of a Kenotron, control qualities of a Thyratron, and efficiency of a Phanotron. Westinghouse Electric Corporation.



Aeronautical Uses of Gas Turbines

The probable fields of use of the three types of aircraft power plants are shown at the left in the top figure. The lower figure gives a general comparison of the characteristics of three airplanes under the take-off and cruise conditions shown in Tables 1 and 2.

TABLE 1
Take-Off Conditions.

	Gross Wt. (Lbs.)	Installed Power Plant Wt. (Lbs.)	Fuel Wt. (Lbs.)	Take-Off Thrust (Lbs.)
Conventional	120,000	20,800	40,000	28,000
Turbine Propeller	120,000	15,200	45,600	44,000
Jet Propelled	120,000	8,000	52,800	24,000

Cruising conditions are shown in Table 2. Jet cruising is on four engines at 35,000 ft. and on two engines at 20,000 ft.; fuel consumption with four jet engines operating is prohibitive for any operations other than at take-off or extremely high altitudes. Cruising with four gas turbine propellers in use is tabulated, as well as with two turbine propellers in use and two feathered; a suitable drag allowance has been made for the feathered propellers.

TABLE 2
Cruise Conditions (20,000 Ft. Altitude).

	Best Cruising Speed, M.P.H.	Miles per Lb. Fuel	Extreme Range, Miles
Conventional	250	0.120	4,800
Turbine Propeller (four engines)	300	0.125	5,700
Turbine Propeller (two engines)	280	0.145	6,600
Jet Propelled (two engines)	350	0.050	2,650
Jet Propelled (four engines 35,000 ft. altitude)	460	0.066	3,000

An Appreciation

TO CORPORATE MEMBERS OF THE INSTITUTE OF THE AERONAUTICAL SCIENCES

Listed below are the leading aeronautical and industrial companies that make possible the publication of the *Journal of the Aeronautical Sciences*.

They enable the Institute to publish scientific and technical papers in the *Journal* and to devote its pages exclusively to editorial material.

Dues from individual members which would normally be used to publish this scientific and engineering quarterly are thus released for additional services to the profession and industry.

Advertising defrays the cost of publishing the *Aeronautical Engineering Review* and the *Aeronautical Engineering Catalog*.

These publications provide a comprehensive technical information service for the benefit of the aircraft and related industries.

ACADEMY OF AERONAUTICS
ADEL PRECISION PRODUCTS CORPORATION
AERO INSURANCE UNDERWRITERS
AEROJET ENGINEERING CORPORATION
AERONAUTICAL PRODUCTS, INC.
AEROQUIP CORPORATION
AGAWAM AIRCRAFT PRODUCTS, INC.
AIRCHOX COMPANY DIVISION, JOYCE AVIATION, INC.
AIRCRAFT RADIO CORPORATION
AIREON MANUFACTURING CORPORATION
AIRESEARCH MANUFACTURING COMPANY
AIRESEARCH MANUFACTURING COMPANY OF ARIZONA, INC.
AIREX MANUFACTURING COMPANY, INC.
ALLIS-CHALMERS MANUFACTURING COMPANY
ALLISON DIVISION, GENERAL MOTORS CORPORATION
ALUMINUM COMPANY OF AMERICA
AMERICAN AIRLINES, INC.
AMERICAN BOSCH CORPORATION
AMERICAN CENTRAL MANUFACTURING CORPORATION
AMERICAN EXPORT AIRLINES, INC.
AMERICAN PHENOLIC CORPORATION
THE AMERICAN ROLLING MILL COMPANY
AMERICAN TUBE BENDING COMPANY, INC.
ASSOCIATED AVIATION UNDERWRITERS
ASSOCIATED FOUNDRIES & MANUFACTURERS, INC.
BAKER STEEL & TUBE COMPANY
BAUSCH & LOMB OPTICAL COMPANY
BEECH AIRCRAFT CORPORATION
BELL AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
BENDIX PRODUCTS DIVISION
BENDIX RADIO CORPORATION
ECLIPSE-PIONEER DIVISION
EXPORT DIVISION
JULIEN P. FRIEZ & SONS DIVISION
PACIFIC DIVISION
SCINTILLA MAGNETO COMPANY
THE BG CORPORATION
BOEING AIRCRAFT COMPANY
BOEING SCHOOL OF AERONAUTICS
BOLTON MANUFACTURING CORPORATION
BOOTS AIRCRAFT NUT CORPORATION
BREEZE CORPORATIONS, INC.
ESSEX TOOL & DIE COMPANY
FEDERAL LABORATORIES, INC.
CARRIER CORPORATION
CESSNA AIRCRAFT COMPANY
CHANDLER-EVANS CORPORATION
CHASE NATIONAL BANK OF THE CITY OF NEW YORK
THE CLEVELAND GRAPHITE BRONZE COMPANY
THE CLEVELAND PNEUMATIC TOOL COMPANY
AUTOMOTIVE-AIRCRAFT DIVISION
CLIFFORD MANUFACTURING COMPANY
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
NASHVILLE DIVISION
STINSON AIRCRAFT DIVISION
CONTINENTAL MOTORS CORPORATION
CULVER AIRCRAFT CORPORATION
CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION
PROPELLER DIVISION
WRIGHT AERONAUTICAL CORPORATION
DOAK AIRCRAFT COMPANY, INC.
DOUGLAS AIRCRAFT COMPANY, INC.
EL SEGUNDO PLANT
LONG BEACH PLANT
THE DOW CHEMICAL COMPANY
DZUS FASTENER COMPANY, INC.
EASTERN AIR LINES, INC.
EATON MANUFACTURING COMPANY
THOMAS A. EDISON COMPANY, INC., INSTRUMENT DIVISION
EDO AIRCRAFT CORPORATION
ELASTIC STOP NUT CORPORATION OF AMERICA
THE ELECTRIC AUTO-LITE COMPANY
ELECTROL INCORPORATED
ENGINEERING AND RESEARCH CORPORATION
ETHYL CORPORATION
THE FAFNIR BEARING COMPANY
FAIRCHILD CAMERA & INSTRUMENT CORPORATION
FAIRCHILD AERIAL SURVEYS, INC.
FAIRCHILD ENGINE AND AIRPLANE CORPORATION
DURAMOLD DIVISION
FAIRCHILD AIRCRAFT DIVISION
RANGER AIRCRAFT ENGINES DIVISION
FEDERAL TELEPHONE AND RADIO CORPORATION
FIRESTONE AIRCRAFT COMPANY
FLEETWINGS DIVISION, KAISER CARGO, INC.
FLETCHER AVIATION CORPORATION
G & A AIRCRAFT, INC.
GENERAL AIRCRAFT EQUIPMENT, INC.
GENERAL AVIATION EQUIPMENT COMPANY, INC.
GENERAL ELECTRIC COMPANY
GENERAL INSTRUMENT CORPORATION
GENERAL MOTORS CORPORATION
AC SPARK PLUG DIVISION
AERO PRODUCTS DIVISION
BUICK MOTOR DIVISION
CADILLAC MOTOR CAR DIVISION
CHEVROLET MOTOR DIVISION
DELCO PRODUCTS DIVISION
DELCO-REMY DIVISION
EASTERN AIRCRAFT DIVISION
FISHER BODY DIVISION
FRIGIDAIRE DIVISION
HARRISON RADIATOR DIVISION
RESEARCH LABORATORIES DIVISION
ROCHESTER PRODUCTS DIVISION
GENERAL TIRE & RUBBER COMPANY
THE B. F. GOODRICH COMPANY
THE GOODYEAR TIRE & RUBBER COMPANY
GRAND CENTRAL AIRPORT COMPANY
THE GRAY MANUFACTURING COMPANY
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
W. & L. E. GURLEY
HANNA ENGINEERING WORKS
HASKELITE MANUFACTURING CORPORATION
HAYES INDUSTRIES, INC.
HIGGINS AIRCRAFT, INC.
THE INTERNATIONAL NICKEL COMPANY
IRVING AIR CHUTE COMPANY, INC.
JACK & HEINTZ, INC.
JACOBS AIRCRAFT ENGINE COMPANY
CASEY JONES SCHOOL OF AERONAUTICS, INC.
KELLETT AIRCRAFT CORPORATION
KENYON INSTRUMENT COMPANY, INC.
WALTER KIDDE & COMPANY, INC.
KOLLSMAN INSTRUMENT DIVISION, SQUARE D COMPANY
LAISTER-KAUFFMANN AIRCRAFT CORPORATION
LANGLEY CORPORATION
LAVELLE AIRCRAFT CORPORATION
LEAR INCORPORATED
LIBERTY AIRCRAFT PRODUCTS CORPORATION
LIGHTS, INCORPORATED
LINK AVIATION DEVICES, INC.
THE LIQUIDOMETER CORPORATION
LOCKHEED AIRCRAFT CORPORATION
LONGINES-WITTNAUER WATCH COMPANY, INC.
MAGNAFLUX CORPORATION
THE MARQUETTE METAL PRODUCTS COMPANY
THE GLENN L. MARTIN COMPANY
WARREN McARTHUR CORPORATION
McDONNELL AIRCRAFT CORPORATION
MENASCO MANUFACTURING COMPANY
MICROMATIC HONE CORPORATION
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
MOORE DROP FORGING COMPANY
NASH-KELVINATOR CORPORATION
NATIONAL CITY BANK OF NEW YORK
NATIONAL CREDIT OFFICE, INC.
THE NATIONAL SCREW & MANUFACTURING COMPANY
THE NEW YORK AIR BRAKE COMPANY
NOORDUYN AVIATION LIMITED
NORMA-HOFFMANN BEARINGS CORPORATION
NORTH AMERICAN AVIATION, INC.
NORTH AMERICAN AVIATION, INC., OF TEXAS
NORTHROP AIRCRAFT, INC.
NORTHWEST AIRLINES, INC.
OTTO AVIATION CORPORATION
OWENS-CORNING FIBERGLAS CORPORATION
PACKARD MOTOR CAR COMPANY
PAN AMERICAN AIRWAYS SYSTEM
THE PARKER APPLIANCE COMPANY
PENNSYLVANIA-CENTRAL AIRLINES CORPORATION
PESCO PRODUCTS COMPANY DIVISION, BORG-WARNER CORPORATION
PHILLIPS PETROLEUM COMPANY
PIONEER PARACHUTE COMPANY, INC.
THE PURE OIL COMPANY
REPUBLIC AVIATION CORPORATION
J. P. RIDDLE COMPANY
RIDGEFIELD MANUFACTURING CORPORATION, AIRCRAFT DIVISION
JOHN A. ROEBLING'S SONS COMPANY
ROHR AIRCRAFT CORPORATION
ROMEC PUMP COMPANY
ROOSEVELT FIELD, INC.
THE RYAN AERONAUTICAL COMPANY
SCIAKY BROTHERS
SCOTT AVIATION CORPORATION
SHAKESPEARE PRODUCTS COMPANY
SHELL OIL COMPANY, INC.
SIMMONDS AEROCESSORIES, INC.
SKYDYNE, INC.
SOCONY-VACUUM OIL COMPANY
SOLAR AIRCRAFT COMPANY
SPERRY GYROSCOPE COMPANY, INC.
SQUARE D COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
STANDARD OIL COMPANY (INDIANA)
STANDARD OIL COMPANY OF NEW JERSEY
STEEL IMPROVEMENT & FORGE COMPANY
SUMMERILL TUBING COMPANY
SWEDLOW AEROPLASTICS CORPORATION
TELEFLEX LIMITED
THE TEXAS COMPANY
THOMPSON PRODUCTS, INC.
TINNERMAN PRODUCTS, INC.
TITEFLEX, INC.
TRANSCONTINENTAL & WESTERN AIR, INC.
TRIPLETT & BARTON, INC.
UNION CARBIDE AND CARBON CORPORATION
BAKELITE CORPORATION
HAYNES STELLITE COMPANY
LINDE AIR PRODUCTS COMPANY
NATIONAL CARBON COMPANY
UNITED AIRCRAFT CORPORATION
CHANCE VOUGHT AIRCRAFT DIVISION
HAMILTON STANDARD PROPELLERS DIVISION
PRATT & WHITNEY AIRCRAFT DIVISION
PRATT & WHITNEY AIRCRAFT CORPORATION OF MISSOURI
SIKORSKY AIRCRAFT DIVISION
UNITED AIR LINES, INC.
UNITED STATES AVIATION UNDERWRITERS, INC.
UNITED STATES RUBBER COMPANY
DOMINION RUBBER COMPANY, LTD.
UNIVERSAL MOULDED PRODUCTS CORPORATION
THE VARIETY AIRCRAFT CORPORATION
VICKERS, INC.
VICTOR ADDING MACHINE COMPANY
VIDAL RESEARCH CORPORATION
THE WACO AIRCRAFT COMPANY
WARNER AIRCRAFT CORPORATION
THE WEATHERHEAD COMPANY
WESTERN AIRLINES, INC.
WESTINGHOUSE ELECTRIC CORPORATION
WESTON ELECTRICAL INSTRUMENT CORPORATION
WYMAN-GORDON COMPANY
YOUNG RADIATOR COMPANY

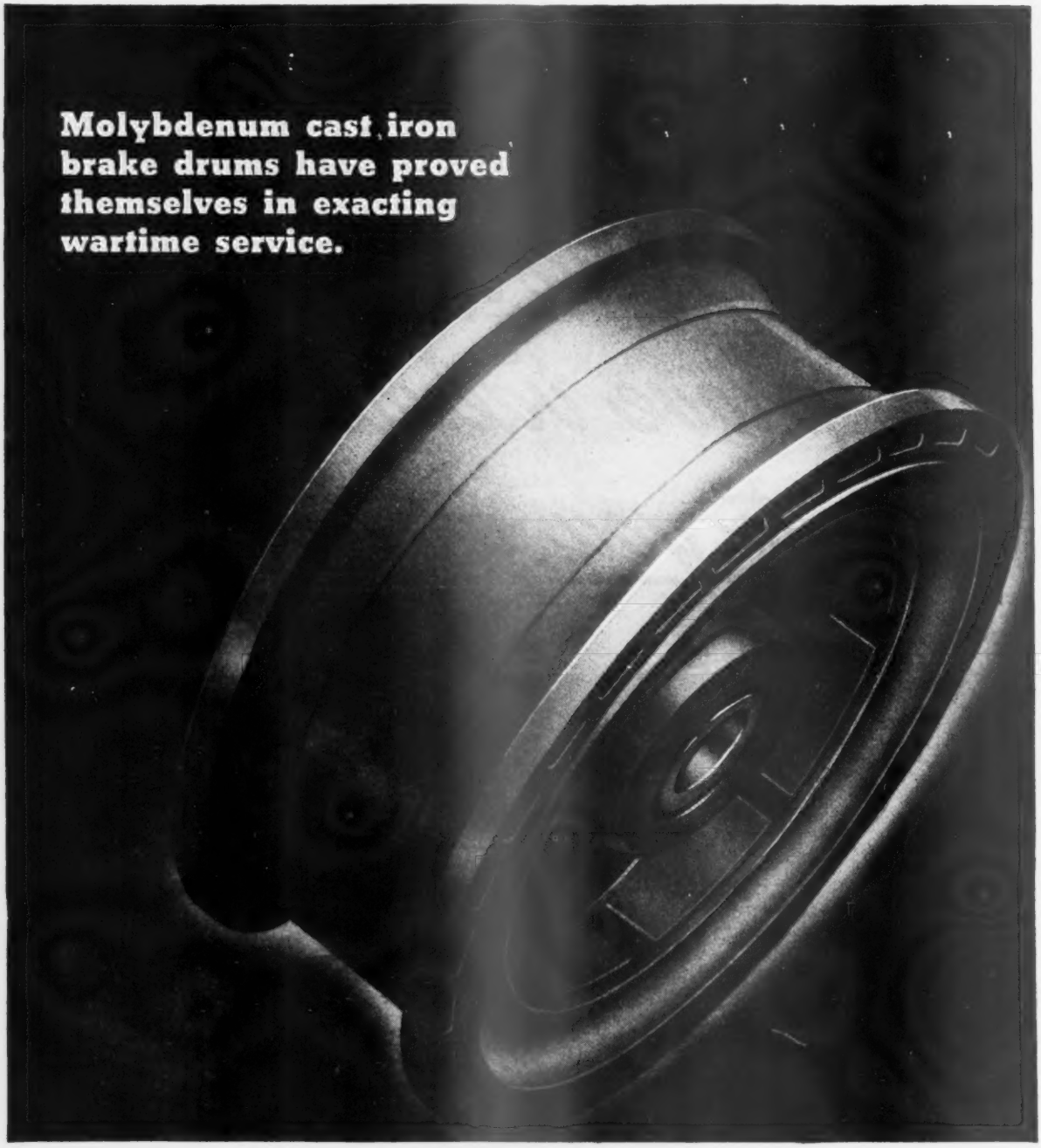
Someday, improved elements in design may prove valuable to you, with...

POLLAK MANUFACTURING COMPANY

Arlington, New Jersey

DEVELOPING • DESIGNING • MACHINE WORK • SPINNING

GAS AND RESISTANCE WELDING • STAMPING • ELECTRICAL WORK



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue • New York City

MOLY

Index to Advertisers

Aeroproducts Division, General Motors Corporation 103
Aeroquip Corporation 8
Air Associates, Inc. 16
Aireon Manufacturing Corporation 92
Airex Manufacturing Company Inc. 84
Allison Division, General Motors Corporation 99
Aluminum Company of America 144
American Rolling Mill Company, The 150
American Telephone & Telegraph Company 130
Automatic Electric Sales Corporation 62

Bakelite Corporation, Union Carbide and Carbon Corporation 40
Bell Aircraft Corporation 132
Bendix Aviation Corporation
Bendix Products Division 54
Eclipse-Pioneer Division (Pioneer Instruments) ....Back Cover
BG Corporation, The 134
Breeze Corporations, Inc. 70
Bunhill Publications Limited 118

Champion Spark Plug Company 81
Chandler-Evans Corporation 168
Chase Brass & Copper Co. Incorporated 129
Clifford Manufacturing Company 137
Climax Molybdenum Company 166
Collins Radio Company 52
Consolidated Vultee Aircraft Corporation 94, 95
Curtiss-Wright Corporation, Wright Aeronautical Corporation Division 69

Darnell Corporation Ltd. 146
Delco-Remy Division, General Motors Corporation 38
Dow Chemical Company, The, Magnesium Division 20
E. I. du Pont de Nemours & Company, Inc., Plastics Department 148

Eaton Manufacturing Company 48
Eclipse-Pioneer Division (Pioneer Instruments), Bendix Aviation Corporation .....Back Cover
Edo Aircraft Corporation 4
Electro Metallurgical Company, Union Carbide and Carbon Corporation 22
Electrol Incorporated 56
Esso Aviation Products 96

Fairchild Engine and Airplane Corporation, Fairchild Aircraft Division 156
Federal Telephone and Radio Corporation, International Telephone and Telegraph Corporation 58
Fischer & Porter Company 114
Flex-O-Tube Company, The 72

G&O Manufacturing Company, The 136
General Electric Company 140, 141
General Motors Corporation
Aeroproducts Division 103
Allison Division 99
Delco-Remy Division 38
Hyatt Bearings Division 124
G. M. Giannini & Company, Inc. 60
B. F. Goodrich Company, The 12, 13
Goodyear Aircraft Corporation 1
Grand Specialties Company 118
Guiberson Corporation, The, Guiberson Diesel Engine Company 154

Haskelite Manufacturing Corporation 158
Hayes Industries, Inc. 122
Holley Carburetor Company 66
Houde Engineering Division, Houdaille-Hershey Corporation 90
Hyatt Bearings Division, General Motors Corporation 124

International Nickel Company, Inc., The 61, 143
International Telephone and Telegraph Corporation, Federal Telephone and Radio Corporation 58

Kellett Aircraft Corporation 116
Kenyon Instrument Company, Inc. 160
Walter Kidde & Company, Inc. .....Inside Back Cover
Kollsman Instrument Division, Square D Company 18

Lamb Electric Company, The 80

Machlett Laboratories, Inc. 24
P. R. Mallory & Company, Inc. 86
Glenn L. Martin Company, The 120
Minneapolis-Honeywell Regulator Company 88

National Screw & Mfg. Co., The 28
Northrop Aircraft, Inc. 74

Ohio Rubber Company, The 78
Owens-Corning Fiberglas Corporation 106

Phillips Petroleum Company 26
Pittsburgh Plate Glass Company 162
Pollak Manufacturing Company 165

Republic Steel Corporation, Alloy Steel Division 64
Revere Copper and Brass Incorporated, Magnesium-Aluminum Division 10
John A. Roebling's Sons Company, Aircord Division 152
Rohr Aircraft Corporation 42
Romec Pump Company .....Inside Front Cover

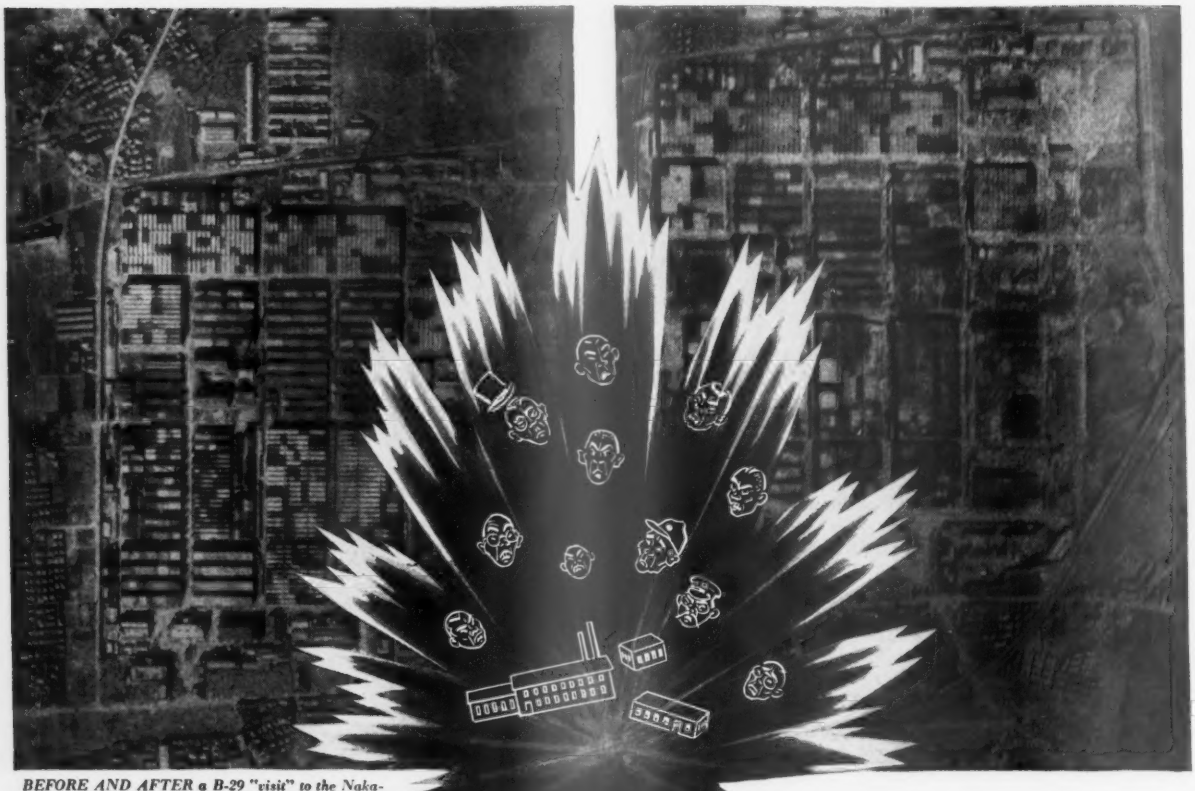
Sinclair Refining Company 138
Skydyne, Inc. 118
Sperry Gyroscope Company, Inc. 104
Square D Company, Kollsman Instrument Division 18
Statham Laboratories 108
Stewart-Warner Corporation, Heater Division 76, 77
Surface Combustion Corporation, Aircraft Heater Division. 14

Teleoptic Company, The 98
Thompson Products, Inc. 126
Time, Inc. 110

Union Aircraft Products Corporation 82
Union Carbide and Carbon Corporation
Bakelite Corporation 40
Electro Metallurgical Company 22
United States Rubber Company 33, 34, 35, 36

Vickers Incorporated 76

Weatherhead Company, The 50
Western Electric Company 112
Westinghouse Electric & Manufacturing Company 30
Wittek Manufacturing Company 100
Wright Aeronautical Corporation Division, Curtiss-Wright Corporation 69
Wyman-Gordon Company 2



BEFORE AND AFTER a B-29 "visit" to the Nakajima Aircraft plant at Ota, Japan. 755,900 square feet of roof lies gutted and blasted. Official Photo U.S.A.A.F.

LOST-- 1 Aircraft Plant 105,226,101 Faces

Losing face — and losing war plants — is a regular Japanese custom these days. It is a habit they don't particularly relish, but they don't seem to be able to do anything about it.

For there isn't much argument you can put up against a fleet of, say, 300 B-29's. They go where they wish, when they wish, hit what they're aiming at. And they come back again and again.

As the size and power of these Superfortress fleets increase, so does the responsibility of all Chandler-Evans workers. For an integral part of the great Wright engines that power these bombers are CECO carburetors. They are part of the great team of parts that go into the making of a Boeing B-29. They must function perfectly and efficiently regardless of altitude or temperature. Above all, they must be dependable.

We pledge that no single thing will be overlooked to maintain, and better, the high standards that have earned CECO carburetors this responsibility.

CECO

CARBURETORS

FUEL PUMPS

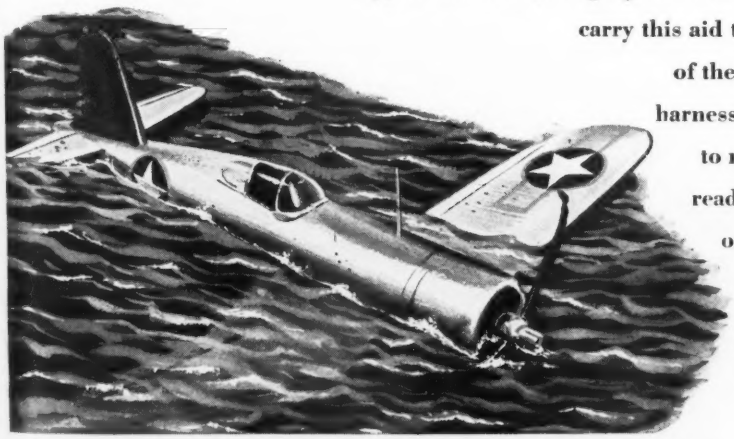
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION

SOUTH MERIDEN
CONNECTICUT, U.S.A.

WHEN DOES A PLANE NEED A LIFE PRESERVER?

Before the war, when carrier-based planes made a forced landing at sea, they floated safely on giant water-wings. ¶ The instant the plane struck the water, Kidde Flotation Gear went into action *automatically*. Carbon dioxide—stored under high pressure—was released by the action of a water-sensitive mechanism . . . inflating rubberized bags stored in wing compartments. Out popped the bags—to keep plane and crew afloat till rescue arrived! ¶ During the war, Kidde Flotation Gear has given place to armor and armament; its weight has been sacrificed in the interests of speed and maneuverability. The *crew* is saved by Kidde-inflated rafts, but the plane itself is expendable. ¶ But when the war is over, Kidde Flotation Gear will find a host of new applications. Many types of aircraft, winging over water on long-distance flights, will probably carry this aid to safety. ¶ Flotation Gear is one of the many devices in which Kidde skill has harnessed the energy of gases-under-pressure to make flying safer. Kidde engineers are ready to work with *you*—just drop a line to our Product Development Department.



The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

K Kidde

Walter Kidde & Company, Inc. • 140 Cedar Street • New York 6, N. Y.

Pioneer Air Position Indicator provides continuous readings of latitude, longitude, heading and air mileage

Orientation mechanically has now become a fact! Today a pilot or navigator can read directly from a dial his exact position in relation to the air mass through which he travels. With only a simple correction for drift he can establish, *with accuracy*, his geographical position as well. The instrument which makes this possible could only have come from Pioneer*, for the proper functioning of the Air Position Indicator depends in large part on true heading indications—and these in turn can be provided under all conditions only by the Pioneer-created Gyro Flux Gate* Compass. Again Pioneer's Creative Engineering points the way to greater flight security.

PRODUCTS OF **Bendix**

PIONEER INSTRUMENTS

ECLIPSE-PIONEER DIVISION AVIATION CORPORATION

Teterboro, N.J.

*REG. U.S. PAT. OFF.

he Air
ading
ler all
Gate*
ts the